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NATIONAL FISHERIES JOURNAL OF INDIA Vol 22 No.1 April 2002

FISHING CHIMES

A monthly journal devoted to the development of Fishery Industries

Upgrades Capabilities; Augments Output

CONTENTS

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Messages

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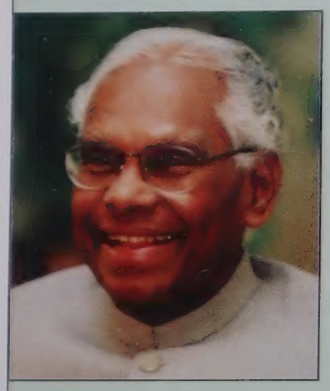

No.F.2-M/2002 13th March, 2002

Dear Shri Dixitulu,

The President of India, Shri K.R. Narayanan, is happy to know that the Fishing Chimes is bringing out a special issue to mark its 22nd year of publication in April, 2002.

The President sends his best wishes for the success of the special issue.

With regards,

Yours sincerely,

(P.P. Kaushik)

KIRANMAY NANDA
MINISTER-IN-CHARGE
DEPARTMENT OF FISHERIES,
AQUACULTURE, AQUATIC RESOURCE
AND FISHING HARBOURS
GOVERNMENT OF WEST BENGAL

কিরণময় নন্দ
ভারপ্রাপ্ত মন্ত্রী
মৎস্য, জলজপ্রাণী বিকাশ, জলজসম্পদ
ও মৎস্য বন্দর বিভাগ
পশ্চিমবঙ্গ সরকার

D.O. NO 53-M/Fsy.

KOLKATA, THE 28th Feb., 2

am glad to learn that Fishing Chimes enters into 22nd year of its dedicated service to the cause of fisheries and fishermen in India, in April, 2002.

An organisation does not live in years but in deeds and I have a firm conviction that Fishing Chimes has not only lived up to the expectation, it given a fillip to fisheries, fishermen and fishing industry as a whole.

I would expect that it will continue to serve the purpose with rededication in the years to come.

I wish the occasion all the best.

(KIRANMOY NANDA

B. RAMANATHA RAI
MINISTER FOR FISHERIES, PORTS
& AREA DEVELOPMENT

TELEPHONE OFF 2251496
RES 2092227

VIDHANA SOUDHA, BANGALORE - 1

NO.MFP & AD/ 89 2002

DATED 06.03.2002

Dear Shri Dixitulu,

It is gratifying to note that "FISHING CHIMES", a popular Indian Fisheries Journal, is entering into 22nd year of publication in April 2002. on this memorable occasion, I congratulate you for your devotion and tireless efforts in bringing out this monthly journal for the last 21 years, improving its quality and standards year after year.

Being a constant Reader of the Journal, I find that the Journal covers thought provoking editorials, research advances, recent development in Inland, estuarine and marine fisheries, proceedings of the International/National symposiums/Seminars/Workshops and raising issues requiring the attention of both State and Central Governments and also events occurring all over and thus providing up to date information on fisheries development. Thus, fishing chimes acts as a most useful guide to all those engaged in fishery industry.

I am sure that this journal will continue to serve the Industry in years to come and contributes its might in improving the Technologies involved and bringing the Socio-Economic revolution in fishermen community and others engaged in this field.

I once again congratulate you on this occasion and wish you all the success in your endeavors.

With regards,

Yours sincerely,

(B.RAMANATH RAI)

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Message

I heartly congratulate the Fishing Chimes on its entering into the 22nd year of its publication. During the last 21 years it had, to its credit, an impressive record of service to the nation by devoting itself to the development of fisheries in India. In the past it successfully dealt with the problems of the fisheries and socio-economic problems of the fishermen.

I hope the journal with the experience gained in the past will be able to contribute more to the fisheries sector of Indian economy. Besides further development of the natural fisheries, there is tremendous scope of developing the small fish farms for the employment of the unemployed.

I expect the Fishing Chimes as a monthly national journal will explore the solution to the fishing problems more intensively to build a better future of the fishermen and those who choose the fish farms as their livelihood.

I wish the Fishing Chimes all success in its endeavour to serve the people by upholding the cause of fisheries sector of the nation.

Dated, Dispu the
20th March, 2002.

(Dr. Hemo Prova Saikia)

Dear Dixi,

Having launched our Professional Fisherman magazine two and a half years ahead of Fishing Chimes, I have always followed Fishing Chimes' progress with considerable interest. Not only have I been interested in Fishing Chimes, but I have continued to be informed, educated and amused by it. My only complaint about the modern Fishing Chimes is that it contains fewer of the great jokes that made the earlier version such fun to read.

My wife and co-director Rose, joins with me in congratulating you for prospering for so long in a period when so many others have fallen by the wayside.

Keep up the good work!

Best regards,

Neil Baird
Chairman & Editor-in-Chief
Professional Fisherman and Fishing Boat World, Baird Publications, 135 Sturt Street, Southbank, Melbourne 3006, Australia

Dear Mr. Dixitulu, e-mail message Feb 18, 2002

"We are happy to note that *Fishing Chimes* has grown and matured into a very informative, industry oriented, reader friendly publication in a relatively short period of 22 years. Let me congratulate you and your team for all the hard work to make this publication achieve such high standards. While assuring our continued cooperation and support, let me convey my best wishes for *Fishing Chimes* to reach even further heights."

Regards

507 28 Kuala Lumpur
Malaysia

S. Subasinghe
Director, INFOFISH

Dear Mr. Dixitulu, e-mail message Feb 5, 2002

Everyone here at FFI, and at our sister fish industry journals in the Heighway stable of titles, wishes *Fishing Chimes* the warmest congratulations on your continuing success. It is in the interests of everyone in the food sector worldwide that the aquaculture industry develops, expands and flourishes, and trade papers play a crucial role by disseminating the latest information and technology, and by helping to keep everyone in the industry in touch with one another. *Fishing Chimes* has been one of the most important journals in this respect over the last 21 years - we wish you every success in continuing this vital service for the next 21 and beyond.

Kind regards

Heighway, Telephone House
69-77 Paul Street
London EC 2A LO, UK

Kenny McCaffrey
Editor
Fish Farming International

April 3, 2002

Dr. G.N. Mitra

Dear Dixitulu,

It is great to know that Fishing Chimes has entered into 22nd year of publication in April 2002. I admire the thoughtful and courageous initiative taken by you in starting the journal and the manner in which you nurtured it all these years. My blessings to the journal and to you.

Congratulations for the award by AIFI to you for your life time achievements. I know of no other man who has contributed so much for promotion of Fisheries in India with comprehensive analysis and constructive guidance in policy, strategy, research, finance and management. I also congratulate the AIFI for placing you at the top of the recipients. Wishing you all the best.

Sincerely yours

G N. Mitra

G.N. Mitra

Professorpara
Cuttuck, Orissa

April 5, 2002

Prof. (Dr.) Hiralal Chaudhuri

Dear Mr. Dixitulu,

Fishing Chimes is a unique journal that has gained popularity all over the country and also abroad over all these years. Its entry into its 22nd year of publication in April 2002 is an auspicious occasion. I have been a regular reader of Fishing Chimes for the past several years. This keeps me well informed of the developments in the fisheries sector.

I avail of this opportunity to offer my felicitations for the growth of the journal from strength to strength and to congratulate you on this unparalleled achievement being the first Indian fisheries journalist successfully striving to disseminate valuable information on developments in the fisheries sector.

Yours sincerely

H. Chaudhuri

(Hiralal Chaudhuri)

CD 218, Salt Lake City
Kolkata - 700 064

21 YEARS OF SERVICE

Celebrating Entry into 22 VOLUME

Fishing Chimes ascends on to its 22nd volume with this issue, throbbing with the strength imparted by the growing quality of its contents over the past 21 volumes (252 numbers) and the expanding patronage and encouraging response from an active readership. The readership is responsive due to the pertinent and pulsative articles published in the journal from time to time. The editor is proud that, occasionally though, requests come in from quite a few foreign institutions asking for reprints of some of the papers published in the journal.

There are three pillars on whose support the journal stands. These pillars are i) professionals, scientists, technocrats, and authors who stud their contributions with profound narrations; ii) development-oriented subscribers and iii) quality products producing advertisers. In fact, the patronage provided by these pillars has been sustaining the journal all these years of growth of the journal.

Their desks with the journal atop inspires fisheries professionals and others; and shelves and tables of several libraries laden with the journal present an inviting stance to the readership.

An encouraging aspect is that students of fisheries colleges and several universities have been now emerging as a new category of subscribers. Further, several post graduate fisheries students have been contributing articles 'on some aspect of fisheries or the other containing fresh ideas,as they strike to them as the uninitiated or the formative group,which is a welcome feature. This issue contains contributions from the chiefs of the various State Fisheries Departments in which the present status of fisheries development in the State concerned and the future plans have been unfolded.

The journal also has the privilage of including valuable contributions by the central fisheries research institutions and from C.I.F.E. This issue also includes an account of Hybridoma Technology - based Farmer Level Immonodot test for Detection of White Spot Virus of Shrimp, authored by K.M. Shankar and his colleagues, a Report on promising field results related to application of CIBA - developed Immunostimulant for controlling and preventing White Spot Disease among cultured shrimps by I.S.Azad and his colleagues. An article on the experiences in the rearing of Rock lobster larvae authored by D.E.Babu and his associates, a write-up on peri-Urban Aquaculture and its Environmental Status in areas around Kolkata, contributed by Madhumita Mukherjee, are the other highlights of this issue, among several others.

We avail of this auspicious occasion of commencement of the 22nd volume of the journal to seek the blessings of the subscribers, advertisers, contributors and the general readership for the progressive strengthening of the journal with ascending hues in terms of quality and readership.

Vol. 22 No.1 FISHING CHIMES APRIL 2002

Estd : 1981

Visakhapatnam, India

Vol. 22 No.1
APRIL 2002

FISHING CHIMES

Time for FSI to share its Mandate

The Fishery Survey of India (FSI), first set up in 1947 as Exploratory Fisheries Project in Mumbai, has emerged over the past 50 years as an unique fishery survey organisation in the south-east Asian region. Spread over all along the Indian coastline in a manner that provides access to conduct fisheries surveys in the Indian EEZ from a number of Bases, FSI's headquarters in Mumbai has developed a well structured system of monitoring the survey work conducted from its various bases. It has been extending a steadfast support to the Indian fishing industry and stood by it in several ways all these years. At the time when CIFNET was not yet established, FSI provided on-board training to deck hands during survey cruises of its vessels and later to a number of CIFNET's trainees to enable them to become Skippers, Mates, Engineers etc. The trained candidates, mostly those trained before CIFNET was set up, became the nucleus to meet the manpower requirements of poineering companies such as Union Carbide and New India Fisheries. The commercially attractive fishing results achieved by these companies blazed a new trail for the Indian fishing industry to blossom in their fishing operations conducted in areas beyond the traditional coastal zone.

The primary credit for locating shrimp grounds off Orissa and West Bengal coasts goes to FSI. This location eventually led to the growth of the industry. Later, FSI located fishing grounds of several commercially important fishes and crustaceans in the Indian EEZ. Tuna grounds, particularly around Lashadweep and A & N Islands and in the high sea zone off the nation 's mainland were located by FSI but the credit for commercially exploiting this resource went mostly to the chartered longliners mostly of Taiwanese ownership. Revalidation of deepsea lobster and deep sea prawn grounds off certain zones of Kerala coast, and location of spear lobster grounds around Andaman & Nicobar islands, Squid and Cuttle fish grounds along west coast, besides several other viable resources have been accomplished by FSI.

The estimated Fisheries resources of Indian EEZ have been revalidated at 3.92 million t recently, but this estimation is at the same level as before. Against this potential, the level of annual exploitation reached as in 2001-02 was 2.8 million t of the resource, thereby leaving a balance of 1.1 million t, which works out to about 28% of the total estimated resource. Most of this balance is reckoned to be in the deep sea zone in the form of both pelagic or demersal resources, and apparently not accessible to the Indian fleet.

Many in the industry believe that the estimate of fisheries resources of Indian EEZ is a conservative one. Their reasoning is based on the premise that, apart from 2.8 million t exploited by the Indian Industry, an additional quantity is exploited by foreign vessels too clandestinely. There is no way to know the quantity that gets exploited in this manner. Once poaching is prevented, and the Indian enterprises are helped either in expanding the fleet strength with suitable types of vessels or in upgrading the present vessels as needed, a line of action for utilising the remaining resources not accesible at present to our fleet would take shape. And this approach would help in locating the grounds containing this estimated balance of resources not being exploited at present by Indian vessels.

Another reaction of the industry is that there can be an underestimate of the resources, deliberately made as an abundant measure of caution. An overestimate means invitation of focal criticism and accusation of inaction in organising the utilisation of the available resources. The critics reinforce their observation with a seemingly logical argument which runs a follows: Around 40,000 mechanised/motorised fishing boats and around 500 nos of vessels of 15m LOA operate in the territorial waters and a little beyond. Around 65 larger vessels of 23-27 m OAL operate in the waters believed to be beyond the coastal strip. Unable to withstand the economic strain because of poor catches, the managements of a few larger vessels shifted their operators to a zone away from the Indian EEZ.

The combined effort of all mechanised/motorised boats

and the larger vessels now yield an annual production of 2.8 million t, the bulk of which is taken from the shelf zone. Stated differently, a substantial area beyond the coastal zone and also the shelf zone is left unfished by the Indian fleet, despite the fact that the resources of this area are sizeable. In this connection, there is a belief in the industrial circles that there are uncharted grounds in the Indian EEZ for deepsea lobsters, deep sea shrimp and cephalopods, mostly of squids and cuttle fishes, which may be lying in irregular patches at undisturbed depths at around 200 m and beyond. It is believed that in the pelagic waters of high seas there are unexploited tuna resources, over and above similar stocks followed and captured by a couple of distant water nations.

According to the critics, it is hard to believe that in an area of 2.02 million sq. km of its EEZ, India has such a low level of resources that can yield only 2.8 mill t a year. In other words, the view is that survey work needs expansion, although there are constraints in the way. One major constraint is that FSI, despite efforts, has not been able to undertake surveys from commercial angle, because of working problems. Night fishing goes against working norms of crew employed to function on government-owned vessels. At present survey work is planned, based on a scientifically designed grid system which is not that conducive for inparting a commercial orientation, particularly because of the working norms which the crew insist upon, as is their right.

FSI plans its survey work utilising the available fleet, taking into account the recommendations made by the main and base-wise adivsory committees it has constituted. Further, FSI has the system of disseminating the results of surveys for the benefit of the industrial enterprises. While these devices have promoted an interface between FSI and the industry, it needs to be strengthened further with a commercial orientation, and this is possible through stimulation of interest among the concerned by way of location of specific and viable fish stocks of commercial interest to the industry. Knowledge in this regard will motivate the industry to acquire new fishing vessels for exploiting such stocks. For want of this knowledge and quite a few other reasons such as advancing age of vessels and constraints in securing financing facility, the strength of industrial fishing fleet of the country has plummeted from around 190 nos to 65 nos.

In this background, there is an imperative need for FSI to share its mandate with the industry in a such a manner that the fishery enterprises can experience for themselves the various aspects of survey work and at the same time contribute to the diversification of survey effort to such newer zones where they can expect to locate hitherto unknown grounds of deep sea shrimp, deep sea lobster, squids and cuttle fish and of other prime fisheries.

The Fishery Survey of India can take the initiative of drawing up a scheme that provides for sharing of survey responsibilities between itself and the Industry, taking into account the views to be offered by the Association of Indian Fishery industries. Broadly visualised, FSI may lease out to selected fishing companies the survey vessels presently in operation, for an adequately long duration governed by the needed terms and conditions. One of these conditions may provide for atleast one representative of FSI to be on board each of the survey vessels to ensure the recording of voyage-wise data in the required format and to ensure that the voyages are purposeful, taking into account the commercial needs. Based on the daily reports from the vessels received at the various bases of FSI, guidance can be imparted to the fishing companies in respect of new viable grounds located, for exploitation. A formula for the transfer of services of the crew members willing to work under commercial terms and conditions with the lessees may be arrived at through mutual consultations between FSI and the leasing company concerned. The lease amount may be fixed, taking into account the depreciated cost of the vessels, the likely operating costs, and the objectives. While the areas to be surveyed could be left to the lessee concerned based on specific proposals put forth, FSI would have to extend the needed guidance to ensure that the surveys progress in a way to deliver results as would be useful. The agreement to be entered into between FSI and the leasee has to be of course finalised through mutual consultations between the Association of Indian Fishery Industries and FSI. The excercise of sharing responsibilities would no doubt bring about a change in the present working style of the various bases of FSI and of the Director General and his scientists at the Main Centre. All the daily data received from the leased vessels, their analysis and the conclusions drawn would provide a new complexion to the work. Further, the reactions of the industry in respect of the operational worthiness of the survey vessels which have become old would have the effect of inducing the government to strengthen the fleet. The results of the survey conducted under the proposed new scheme will bring out sharply the commercial fishing fleet requirements for exploiting the resources as estimated from time to time. Once this aspect is clearly known, the need to help the industry for securing financial support for acquiring new fishing vessels would come out sharply for the government to institute such measures as are necessary for strengthening the survey fleet.

Peri-urban Aquaculture and its Environmental Status : Kolkata Experience

Madhumita Mukherjee, Utpal Nath, Sk. Abdul Kashem and Mohan Chattopadhyay
Deputy Directorate of Fisheries (M&P), Government of West Bengal
Captain Bhery, E.M.Bypass, Kolkata - 700 039, India.

Peri-urban area of Kolkata is a modified and special looking zone, where the city and a village blends. It is unique in the sense that in this zone, the biodegradable human, animal and other domestic wastes of Kolkata are brought in through tunnels that enter its various pockets. During 1990s this peri-urban area of Kolkata that covers a large portion of eastern and southern sections of the metropolis is increasingly being identified as consisting of efficient natural eco-systems for improving waste water quality, controlling flora and fauna of receiving water bodies and, the most important of all, in generating fish and vegetable crops. This zone is a place of ponds, beels and swamps. Here, the city sewage undergoes bio-treatment through production of profitable protein and environmental purification along with employment generation (Mukherjee, 1996; Mukherjee 1988). The peri-urban area, with an extent of 3,500 hectares is an enchanting conglomeration of sewage fed fishery, vegetable production, aquarium fish culture, brackishwater fish culture, floriculture, etc. These socially beneficial activities coexist with both unplanned and planned human settlements (Kundu, 1994). Here the land is preserved because of its unique environmental and ecological status. The area is allowed to act as a natural drainage basin receiving the heavy rainfall and sewage of the city, and, as already stated, islands of agricultural land in this area produce fresh vegetables which are supplied to the city markets, and existing water tanks serve the purpose of producing fish for supply to the fish markets of the metropolis in large quantities (Kundu, 1994). This is specially applicable to different Kolkata wetlands - a unique ecosystem that sustains the world's largest wetland, and it happens to be one of the oldest practices of integrated resource recovery, since the beginning of the last century (Saha, 1970; Mondal, 1996; Jana, 1998). The city's waste-based resource system has also been considered as the best possible and also ecologically balanced land use pattern in urban areas of the world (Chakrabarty, 1998). The Government of West Bengal leaves no stone unturned to preserve the wetland by way of productive use through fish culture, wetland management centres, awareness programmes and successive enactments under India Fisheries Act, 1984 (Nanda, 1998)etc., as conditions of existence demand. In other words, this area receives attention for its upkeep as a model of wastewater aquaculture (Mukherjee, 1998). The State Government has declared 16 June as a Wetland Day and it is being observed for the last 17 years to create awareness of the importance of this wetland among common people.

On going parasitic infections in sewage fed fishery of Sundarban delta (Srivastava and Mukherjee, 1994) and occurrence of helminthiasis among population of this Kolkata suburb (Mukharjee, 1994) also reflect the disease and pollution problem of this area. This paper is based on the author's selective exposure to the sewage-fed fisheries sector in the peri-urban area of Kolkata(W.B., India). It is organised as follows : first part is the overall status and the threat of Kolkata Sewage-fed Fisheries (KSF) as in 2000-2001. The next part prioritises the characteristics of environment of Kolkata Sewage-fed Fisheries and the last part brings out the strategies for the future.

East Kolkata Wetlands - Present Status

East Kolkata is the largest single system in the world utilising sewage waters for fish production. In 1959-60, total area of these water recycling-cum wetlands, was about 18,000 acres in the Police Station limits of Bhangar, Tollygunj, Sonarpur, Dum Dum etc. But due to severe human interference by way of large scale conversion into sewage-free land, the area has now come down to 7,500 acres (40%) only in the Police Station limits of Tiljala, Salt Lake, Bhangore and Sonarpur.

These threats are in vogue because : 1) Of insufficient understanding within decision takers about the importance of the wetlands; 2) Conversion projects taken up due to political compulsion have to be showcased, the easiest to do near the city because, in other areas, there are infrastructure problems;and 3) Greed, especially where businessmen/ developer, are involved. Surely NRIs must be more sensitive to such issues.

East Kolkata Sewage-fed Fisheries

Locations: Name of District : 24-Parganas (North & South); No. of Police Stations : 4(Salt Lake, Tiljala, Bhangor & Sonarpur), and No.of Mouzas;29

Particulars of Fisheries (Bheries) : No. of *Fisheries* Units :245; Total *Water Area* under *Culture* : 7,262.11 acres; *Dominant* variety of species : Indian Major Carps, Common carp & Tilapia. Recently Pangus and *M.rosenbergii* have also been introduced ;

Average Productivity : 5.16 mt/ha; and *Production constraints* : 1. Unreliable seed quality as there is no quality control; 2. Unscientific traditional culture; 3. Disease; and 4. Law and order situation.

Employment Status : Total No. of Permanent Labour (approx.) : (a)Male-6,700, (b)Female-1,059; Total No. of Ca-

Main Diseases	*Child*	*Adult*
Malnutrition with anaemia	30%	45%
Diarrhoea	45%	60%
Skin	20%	25%
Dental, ENT	25%	35%
Blood Sugar & Pressure	-	20%
Eye	20%	30%
Worm	80%	70%
Depression	-	75%
Respiratory tract infection	40%	40%
Menopausal Syndrome	-	30%

sual Labour: (a)Male-990, (b)Female-163; Daily Wage : Rs. 45/- to 68/-;

Quantity of Sewage : Availability (approx.) : 1,20,000 gallons per ha. per week, and Quantity of Sewage Actually Required : 3,50,000 gallons per ha. per week.

Demographic Status: Total population: 60,000 (approx.); Male : 49%; Female: 51%; Women(19-45 yrs) : 45%; Children(0-3 yrs) : 10%; Boys (11-19 yrs): 25%; and Girls(11-19 yrs) : 25%

Social Status : *Caste* : Schedule Caste - 65%,Schedule Tribe-20%, Other Backward Castes-5%, General Castes-10%; *Occupation* : Fishers-58%(including marketing and infrastructure engagement), Daily Labour/Agriculture 39%, Sex Workers 2%; *Religion* : Hindu 82%, Muslim and other communities 18% : Migration factor:Mostly inhabitants of these areas; Population Below Poverty Line : 70% ; *Decision Maker* : In every family husband's role is predominant ; *Alcohol Addiction*: Approx. 80% of Male and 10% of Female; *Family Planning*: 40% of women population are adopting family planning norms; *Average Monthly* Income : Rs. 900/- to Rs. 1500/-; *Major Illness* : Worms infestation, Scabies, Malnutirtion, Seasonal Diarrhoea, Respiratory tract infection, dental problem, and psychological depression among women : and, Education : Approximately 5% female and 10% male are having basic education upto class VIII standard.

Life style and Environment of the Stake Holders : These areas are having the facilities of primary education. But majority of them are not having adequate facilities for higher education;

Most of the link roads are "Kutcha" (earthen) rendering them unmotorable. Transport facilities are poor. Most of them travel by cycle; There are 15% "pucca" (masonry) houses and the rest are hutments; Electricity is not available in most of the houses; Hand tubewell or pond water is the main source of water; Sanitation facility is very poor, and neither hospitals nor qualified doctors are available in these localities.

Need based priorities : During the survey, requirement of the dwellers of these different localities has been identified and the common needs of these people as per priority has been recorded as under: (1) Electricity (2) Road (3) Education (4) Housing (5) Medical (6) Sanitation and (7) Self-employment.

Present Status on Waste Water Discharge in East Kolkata Land Area

The entire sewage of Kolkata city is taken through a network of drains into a dry weather flow channel which leads directly to sedimentation tanks. From there the sewage is led into a storm water flow channel, which ultimately falls into river Kulti. Both dry weather flow and storm water flow channels pass through the extensive Vidyadhari spill area where profitable fish culture is carried out since decades. The Vidyadhari sewage-fed fisheries comprise the north and south Salt lake regions of Kolkata including the area of Sonarpur L.A. area (Khayada I, Khayada II, Tarada Anchal, Bamanghata Anchal etc.). The entire Kolkata municipal sewage is controlled from Bantala settling yard through nine gates of the pumping station. The gates of the yard regulate the level of the sewage water. At present all the gates of the yard are closed. They were last opened on 25 November 2000. The nine gates (out of 10) were opened for flushing out the excess sewage mixed rainwater. Due to sedimentation of the feeder channel, the sewage water can outflow to the different areas of the sewage-fed fisheries. The municipal garbage also obstructs the feeder channel. The Tapsia channel has become partially closed up due to deposition of municipal garbage. The Tapsia channel has three gates, which are operated twice in a week. Due to the siltation of the feeder channels the entire system has become jeopardised. Consequently, the entire sewage-fed fishery areas in the fringe of East Kolkata have been partly or wholly disturbed because of inadequate availability of sewage waters for fish culture.

Status of the Sewage-fed Fish Production

Regarding Disease and parasites the bhery fishes are practically free from major diseases. Among animal parasites Myxosporidian cysts are seen to occur in plenty on the gills of rohu and catla and also *Myxobolus* cysts on the surface of their bodies. The low or no infection with helminth parasites, particularly trematodes, cestodes and nematodes in bheri fishes, can be attributed to their life cycle, which has a free-living larval stage. The sewage water appears to be toxic for their survival, before reaching the fish host. This corroborates the fact that the cercaria are present in molluscs but their adults are absent in fishes. In some cases, the cercaria transform into metacercaria in molluscs and the birds get infected after eating them. The larvae of acanthocephala develop in insects which some how find their way in to bhery water and enter the food chain of fish, thus releasing the larvae of acanthocephalans in fish to mature. Further, infected insects are normally found on the surface of water and thus *Catla catla*, being surface feeder, gets heavily infected with Acanthocephala, but *Labeo rohita* remains almost free from this parasite (Srivastava and Mukherjee,

1994). Evidently bhery fishes are comparatively cleaner though their growth may be poor due to the factors other than parasites and diseases.

Microbiological Status of Sewage-fed ponds

The inlet and settled water from Captain Bhery were collected throughout the year, fortnightly. The samples were filtered and thereafter a series of dilutions were made. Each sample was incubated in Nutrient Agar, Presence-Absence broth (specially for coliform and *E.coli*), MacConky Agar and further investigations were carried out with growth in above mentioned media through different bio-chemical tests, selective media, motility test, staining etc. A sensitivity test with different types of antibiotics was also carried out during growth in above mentioned agars.

RESULT

Table 1: Result of microbial analysis of Captain Bhery during Summer (Pre-monsoon) season.

Sl.No.	*Test*	*Inlet Water*	*Settled Bheri Water*
1.	Nutrient Broth	After 24 hours growth found	After 24 hours growth found
2.	Nutrient Agar	After 24 hours growth found	After 24 hours growth found
3.	MacConkey Agar	After 24 hours growth found	After 24 hours growth found
4.	S.S.Agar	After 24 hours growth found	After 24 hours growth found
5.	Presence-Absence Broth for E.coli	+ve	+ve
6.	TCBS	No growth even after 48 hours of incubation	No growth even after 48 hours of incubation
7.	Total Coliform	>16 MPN/100 ml	3.6 MPN/100ml
8.	Colony count	51.2 x 10^5/ml	12.4x10^5/ml
9.	Gram Stain	Plenty of Gram+ve Cocci in chain & cluster if Gram-ve bacilli found	Gram +ve Cocci & bacilli found

Table 2: Result of microbial analysis of Captain Bheri during monsoon season

S.No.	*Test*	*Inlet Water*	*Settled Bheri Water*
1.	Nutrient Broth	After 24 hours growth found	After 24 hours growth found
2.	Nutrient Agar	After 24 hours growth found	After 24 hours growth found
3.	MacConkey Agar	After 24 hours growth found	After 24 hours growth found
4.	S.S.Agar	After 24 hours growth found	After 24 hours growth found
5.	Presence-Absence Broth for E.coli	+ve	+ve
6.	TCBS	Growth found after 48 hours of incubation	No growth even after 48 hours of incubation
7.	Colony count in TCBS	20/ml	-----
8.	Total Coliform	12.0 MPN/100 ml	2.2 MPN/100ml
9.	Colony count	47.1x10^5/ml	11.3x10^5 ml
10.	Gram Stain	Gram +ve Cocci and gram -ve bacilli found	Gram +ve Cocci & bacilli found

OBSERVATION

Microbial investigations in different media are the result of positive or negative tests which are described in Table 1, Table 2 and Table 3. Further confirmations were made by the use of selective media (eg. TCBS kepars media, SSAgar, LIA etc) and biochemical tests(eg., Salt-agar tolerence tests, MOF, Indole, Urease, TSI, Simone Citrate MRVP etc.). In all cases *E.coli, Salmonella, Shigella, Staphyloccusaurius, Streptococci,* and *Micrococci* were found. In inlet water *Vibrio cholera, V.parahaemolyticus* were found during monsoon months, whereas in summer season, *Proteus vulgaris* was found. From the above results it is seen that the pathogenic bacteria count is much less in settled water, compared with inlet water. Bacteria of Vibrioceae family are found in inlet water during the monsoon season, but the bacteria count is far too low. This pathogenic bacteria is not found either in inlet or in outlet water in rest of the season. The water in the *Bheris* is normally retained for 9-10 days. Within this period the bacterial count drastically comes down and if the period of retention is increased the count may come down below limit further. Keeping this in view, appropriate course of action concerning pollution control in sewage-fed fishery needs to be taken. A series of drug sensitivity tests of the above mentioned bacteria have been elaborated in Table 4.

Present Status of the Water Chemistry of Sewage-fed Ponds

Studies on water chemistry of sew-

Table 3: Result of microbial analysis of Captain Bhery during post monsoon Period

Sl.No.	Test	Intel Water	Settled Bheri Water
1.	Nutrient Broth	Growth found after 24 hours of incubation	Growth found after 24 hours of incubation
2.	Nutrient Agar	Growth found after 24 hours of incubation	Growth found after 24 hours of incubation
3.	MacConkey Agar	Growth found after 24 hours of incubation	Growth found after 24 hours of incubation
4.	S.S.Agar	Growth found after 24 hours of incubation	Growth found after 24 hours of incubation
5.	Presence-Absence Broth for E.colo	+ve	+ve
6.	TCBS	No growth even after 48 hours of incubation	No growth even after 48 hours of incubation
7.	Total Coliform	9.2 MPN/100ml	1.1 MPN/100 ml
8.	Colony count	32.2 x 10^5/ml	10.3 x 10^5/ml
9.	Gram Stain	Gram +VE Cocci & gram -ve bacilli found	Gram +VE Cocci & gram -ve bacilli found

Table 4: Antibiotic Sensitivity Test for Pathogenic Bacteria

	Intel Water Colony		Settled Bhery Water Colony	
Antibiotics	Sensitive	Resistant	Sensitive	Resistant
Chloramphenical	15mm	--	35mm	--
Streptomycin	15mm	--	25mm	--
Oxytetracycline	25mm	--	20mm	--
Furazolidone	20mm	--	20mm	--
Amoxycillin	--	--	17mm	--
Cephalexin	22mm	R	18mm	--
Tetracycline	10mm	--	20mm	--
Cefazoline	10mm	--	--	R
Amikacin	14mm	--	18mm	--

Table 5: Water Quality Parameters of Captain Bhery

Captain Bhery	COD mg/lt	BOD mg/lt	pH	D.O. mg/lt	NH_4^+-N mg/lt	PO_4^{3-} (Reactive) mg/lt	NO_3-N mg/lt
Inlet	150-180	34.58-116.4	7.26- 8.2	0-0.8	0.107-0.32	0.340-0.4	0.52-0.8
Settled Pond	84-97	2.1-5.7	8.7- 9.55	3-12	0.001- 0.005	2.3-5.6	0.102-0.42

Table 6: Heavy Metal Levels in Sewage-fed System

Firm Number	Sample	Zn (mg/l)	Cu (mg/l)	Cr (mg/l)	Cd (mg/l)	Pb (mg/l)
01	(Water)	0.9	0.2	0.15	0.02	0.6
02	(Sediment)	13.5	16.8	0.13	1.72	4.9
03	-do-	5.3	8.6	0.08	0.48	2.7
04	-do-	5.0	2.2	0.01	0.03	1.1
05	-do-	7.7	2.4	0.06	0.00	3.1

age-fed have been undertaken for 12 months. Examination of water quality parameters at inlet points and growing ponds (settled water) revealed that a drastic change, has been found in the case of B.O.D. and C.O.D. These values were high at inlet points, B.O.D. (35-117 mg/lt), C.O.D. (150-180 mg/lt)whereas these values had remarkably come down in the growing ponds, B.O.D(2-6 mg/lt) and C.O.D.(84-97 mg/lt). Variation of physico-chemical parameters like pH, DO at inlet points are as follows: pH varied from 7.2-8.2 and DO from 0 to 0.8 mg/lt, but the growing pond pH varied from 8.7 to 9.5 and DO 3-12 mg/lt.

Nitrogen and phosphorous are the limiting factors in aquaculture in terms of availability of nutrients that affect the growth of algae and the other aquatic organisms.

Nitrate and ammonical nitrogen values exhibit a high value at the inlet points viz., NH_4^+-N (0.107-0.320 mg/lt) and NO_3-N (0.52-0.80 mg/lt). In the growing ponds these values showed remarkably reduced values NH_4^+-N (0.001-0.005 mg/lt) and NO_3-N (0.102-0.420 mg/lt). Average water chemistry of Captain Bhery is shown in Table 5.

Pollution Status of Sewage-fed Ponds

Location of Captain Bheri is very significant. It receives the sewage from Beliaghata canal. At least 50 small scale industries (tannery, leather goods, plastic goods, chemicals, paper mills etc.) are well established at the side of this canal. Though the canal mainly carries domestic wastes of Kolkata city, it also receives effluents of these factories and thereby there is a great chance for the sewage to get contaminated by heavy metals.

Bio-accumulation of heavy metals in sewage-fed system is confirmed by taking heavy metal analysis through atomic absorption spectrophotometric method. However examination of fish tissues does

Table 7: Microbial Characterization of pesticide added water

Test	Sample	Media (Nutrient Agar & NacConkey Agar)	TCBS	Colony Count	Gram Stain
Control	Water	Growth found after 24 24 hours of inoculation	No growth even after 48 hours of inoculation	1.40×10^5/ml	-ve
Aquarium-II	Water	-do-	-do-	2.29×10^5/ml	+ve & -ve
Aquarium-III	Water	-do-	-do-	3.92×10^5/ml	-do-

not indicate the presence of such metal in a significant quantity. (Table 6).

On the other side, a number of farmers grow green vegetables using the solid waste that comes in from Kolkata city (the Dhapa region). They use pesticides to prevent pest attacks to vegetables. It has been observed that from adjoining crop fields pesticides were drained into culture ponds (Konar *et. al.* 1997). resulting in depletion in fish yields.

The following experiments were conducted in laboratory condition to determine whether pesticide contamination affects fish health and water microbiology. The experiment with application of pesticide started on 12.01.2001. Three aquaria were washed thoroughly with 'Extran' (E. Merck), disinfected with Lysol & $KMNo_4$ and cleaned with tap water. These are marked I (control), II and III for testing. The volumes of water taken in aquarium I, II and III were 88 cm x 44 cm x 22 cm = 85.184 cu.dm, 90 cm x 37 cm x 30 cm = 99 cu.dm, & 90 cm x 37 cm x 24 cm = 79.92 cu.dm respectively. A nearby freshwater pond served

Fish from Water to Market in Kolkata Sewagefed Fisheries

Table 8: Physical Observation of Viscera of Fishes kept in pesticide mixed water

	Control	*Aquarium II*	*Aquarium III*
Gut	Gut full with feed	A small amount of feed in gut	Full empty stomach & gut
Gall Bladder	Gall Bladder full with deep green colour bile	Gall Bladder full with light yellow colour bile	Gall Bladder full with yellow colour bile

as the source of water. In each aquarium five numbers of *Tilapia mossambica* were introduced with a stocking density of 50/M^3 (approx.). Average length and weight of each fish was 14 cm & 45 g. In aquarium II & III Dimecron is added at the rate of 0.005 ppm & 0.01 ppm respectively on 12.01.2001. On 24.01.2001 water from the three aquaria was collected aseptically for microbiological testing. After a series of dilutions with physiological saline, diluted water was inoculated in different agar media. These experiments were repeated thrice. The mean values are given in Table 7.

On the same day, three fishes, one from each aquarium were taken for gut contents and gall bladder analysis, and the observations made are given in Table 8.

It will be clear from above Tables that bacterial load was increasing with increase in pesticide concentration. From physical study of dissected fishes, a significant point noted was that, the bile colour had changed from normal green to yellow in fishes kept in pesticide laden water, which is a clear indication of physiological change of the fish exposed to that contaminated water.

Concluding Observation

Water bodies of East Kolkata need to be studied more vigorously and classified differently with reference to aspects, such as pollution level, bio-accumulation of pollutants, floral and faunal diversity, threat perceptions and the like. The present study is intended to inculcate interest and create motivation for such a detailed survey in days to come.

Key Lesson from the Status Survey

Sewage-fed area of Kolkata needs a fresh approach that will enable entrustment of intersectoral coordination and stakeholder participation in the area in order to obtain a steady and sustainable increase in fishery output. The main areas of focus would have to be :

a) An environmental planning and management framework to be developed for the sustainability of Kolkata Sewage-fed fisheries through an agreement between interested parties (Governmental, Industrial & Fishery Sector) on pollution prevention; b) Primary education to be made compulsory for every child, living in the area, to be followed by technical training in different trades ; c) A secondary educational centre to be set up for the willing and the meritorious; d) Setting up of our Adult education centre; e) A permanent health centre to be set up with emergency facilities to cater the basic medical need of the community; and f) To progressively eradicate socially harmful practices, i.e., alcoholism, wife torturing, suicide among women, child delivery at home, and superstitious and orthodox lifestyle, that is predominant among males. It is necessary to set up more number of awareness camps for the purpose.

Awareness camps and door-to-door campaigns are necessary in the following areas:

1. Drug abuse and alcohol practices.
2. Family planning and safe motherhood.
3. Legal rights for the backward classes of women.
4. Self employment by utilisation of local resource.

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US imposes tough shark law

The US federal ban on shark finning has been extended to the Pacific Ocean by the National Marine Fisheries Service (NMFS).

The new regulations implement the Shark Finning Prohibition Act of 2000, making it now illegal for any US regulated fishing vessel to carry or land shark fins without the entire shark carcass.

According to NMFS, this prohibition on shark finning in the Pacific Ocean will "immediately" reduce waste of shark meat and will also prohibit foreign vessels from landing fins in US ports without corresponding shark carcasses.

Finning- the practice of cutting off the fins and throwing the remainder of the shark overboard is pro-hibited under state regulations on the US west coast, in a number of Atlantic states and Hawaii, and has been prohibited in US waters of the Atlantic Ocean, the Gulf of Mexico and the Caribbean Sea since 1993.

According to marine scientists, the life history characterstics of sharks, including slow growth, late sexual maturity and the production of few young, makes them particularly vulnerable careful management of shark fisheries.

Genetic Status and Strategies for Enhancement of Quality of *Catla Catla*, Betterment of Its Broodstock Management and Commercial Production of the Cross breeds

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Karnataka State has some of the richest water resources of the country. Aquaculture in the State is centered on carps. Among these, the Indian Major Carps (IMC: catla, rohu and mrigal) and common carp are the widely used species. The production of seed is controlled almost exclusively by the State with a total of about 30 hatcheries spread throughout the State. Most of these hatcheries exclusively produce common carp which is relatively easy to spawn and seed can be produced almost year round. Only three to five of the hatcheries of the State Fisheries Department produce IMC, which are generally spawned from late May to mid-August. Government-owned hatcheries operate to meet the seed production targets set by the Department. Those producing IMC seed tend to maximize their production during the short spawning season and make up the rest of the requirement to fulfill their target through production of common carp seed. Hatcheries generally produce catla seed in the early part of the season followed by the other two major of the IMC group. Eggs are hatched in "Chinese style" circular flow hatcheries or, less commonly, in incubator jars. The seed is normally collected from a hatchery by the farmer or nursery operator after a very short period of nursing, either at spawn or fry stage.

In 1998/99, the latest year for which data are available, all State-run farms produced a total of 237.70 million seed (fry) and 155.37 million fingerlings were stocked for enhanced aquaculture production (Anon, 2000). Stocking is done mainly in major and minor irrigation tanks and approximately 35% of stocking is represented by common carp, 30% by catla, 25% rohu and only 10% by mrigal.

There is a common perception amongst farmers and fisheries department officials that there has been a steady decline in the performance of major carps, over recent years in terms of growth rate and yield. There is concern in this regard but this seems greater in respect of catla than for other species due more to its importance as the fastest growing species rather than its rate of decline. There is much anecdotal evidence for this, coming mainly from the farmers involved in the culture of the fish. Unfortunately there are little, if any, data available either to support or contradict this hypothesis of reduced performance. However, previous studies investigating the management of hatcheries from a genetic perspective have concluded that the management techniques applied are likely to result not only in inbreeding but also in negative selection for some commercially important traits (Eknath and Doyle, 1985; Eknath and Doyle, 1990). The breeding charachteristics of the species itself subject it to the risk of inbreeding under domestication. It is a highly fecund species, commonly producing well in excess of 100,000 eggs per kg of spawning female. So much so, seed requirements can be met with relatively small numbers of broodstock. Broodstock replacement strategies may also further reduce effective population sizes resulting in inbreeding. Apart from the problems associated with broodstock management, little is known of the founder stocks first introduced into the State at the beginning of the development of the industry in the early and mid 1960s. It is not clear where the fish came from or indeed how many of them were introduced and spawned to produce the first generation. It seems likely that there were introductions more than once and it is possible that founder stock quality also contributed to inbreeding. It was against this background that a study was undertaken in collaboration with the State Directorate of Fisheries (DOD) to assess the present genetic status of IMC (with particular reference to catla) in Karnataka and to suggest possible strategies for improvement. This project was funded by the UK Department for International Development (DFID) under its Fish Genetics Research Programme (now known as the Aquaculture and Fish Genetics Research Programme, AFGRP).

Hatchery management and the genetic status of Catla stocks in Karnataka

This first approach of the study was by way of visiting the larger Indian major carp producing hatcheries in the State to collect data on their broodstock management practices. Initial interviews revealed that there were actually very few hatcheries producing significant numbers of catla seed, although several more produced small numbers of seed (but not necessarily every year).

Comprehensive data sets were collected from six catla-producing hatcheries in the State. All hatcheries were found to have functioned as reproductively isolated units since the introduction of their first stocks of catla and it is likely that there was only one (or possibly two) original sources for these domesticated stocks

(Basavaraju *et al.*, 1998).

In particular, data related to broodstock management practices, including the normal age at first breeding, average number of breeding seasons per brooder, the number of new brooders added to the population each year and the number of new brooders contributing to the replenishment were collected. Most hatcheries maintained scanty records of past production and adopted very ill defined procedures for replacing stock. The seed production at these hatcheries, however, was very much target oriented. Each hatchery was provided by the State Director of Fisheries (DOF) with production targets and attaining these is traditionally regarded by the hatchery managers as their principal objective. With this emphasis on quantity, little or no consideration is given to broodstock or fry quality, especially in relation to the genetic status of the stocks. The common practices of broodstock replacement seemed to be to retain a few fingerlings each year (for being grown into brooders), normally these being collected towards the end of the spawning season, and usually representing no more than two or three families (see Fig 1).

Table 1 shows the estimated effective populations sizes (N_e) and rates of inbreeding accumulation (ΔF) for the stocks of catla at the three major hatcheries where seed of this species is produced (comparative data for other Indian major carp species is also shown). The estimates for effective population sizes vary from 55.5 to as low as 11.4 and for inbreeding rates from 0.90 to 4.40% per annum. At the high end of this range these are almost acceptable population sizes for short-term domestication, although inbreeding would become a problem with the passage several future generations. Clearly the rate of inbreeding in the smaller hatcheries is unacceptably high. It should be emphasised that these estimates have to be treated with some caution due to the difficulty of collecting adequate data as a consequence of the poor records being retained on this subject by most of the hatcheries. Nevertheless, this data does support the hypothesis that hatchery stocks are inbred which is likely to be causing a reduction in their culture performance.

Table 1 : Estimated effective population sizes and rates of inbreeding for major hatchery stocks of *Catla catla* in Karnataka State fish hatcheries (Source ~ Basavaraju, *et al.*,1998)

Hatchery	*Species*	*Ne*	*ΔF (% per annum)*
Tunga Bhadra Dam (TBD)	Catla	55.5(10.5)	0.9(4.7)
	Rohu	23.5(12.3)	2.1(4.0)
	Mrigal	18.4(13.5)	2.7(3.7)
Bhadra Reservoir Project (BRP)	Catla	18.4 (8.5)	3.5(5.9)
	Rohu	14.2 (6.9)	3.5(7.2)
Kabini Reservoir Project (KRP)	Catla	11.4 (4.7)	4.4(10.6)
Shivapura Fish Farm	Insufficient data		
Vanivilas Sagar Fish Farm	Insufficient data		
Munirabad	Insufficient data		

The foregoing account clearly suggests deteriorating genetic status of cultured stocks in Karnataka aquaculture. It is, therefore, highly essential to take appropriate remedial measures to stop further genetic deterioration of these important stocks and initiate suitable corrective measures to improve their performance.

Production and Evaluation of Cross breeds of Inbred Populations

Based on the findings presented above, crosses between the two major hatchery populations in Karnataka (BRP and TBD) were produced and evaluated to test the hypothesis of inbreeding and as a potential short-term measure for genetic gain. This was based on the principle that if the hatchery stocks were

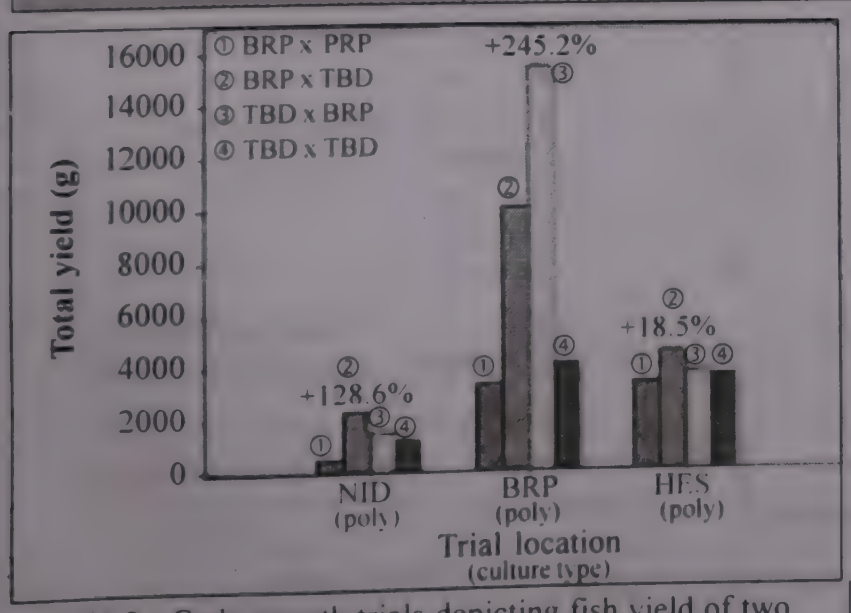

Fig 2 : Catla growth trials depicting fish yield of two crosses and two pure parental stocks during 1996-97. Poly = polyculture (Source Basavaraju *et al.*, 2000).

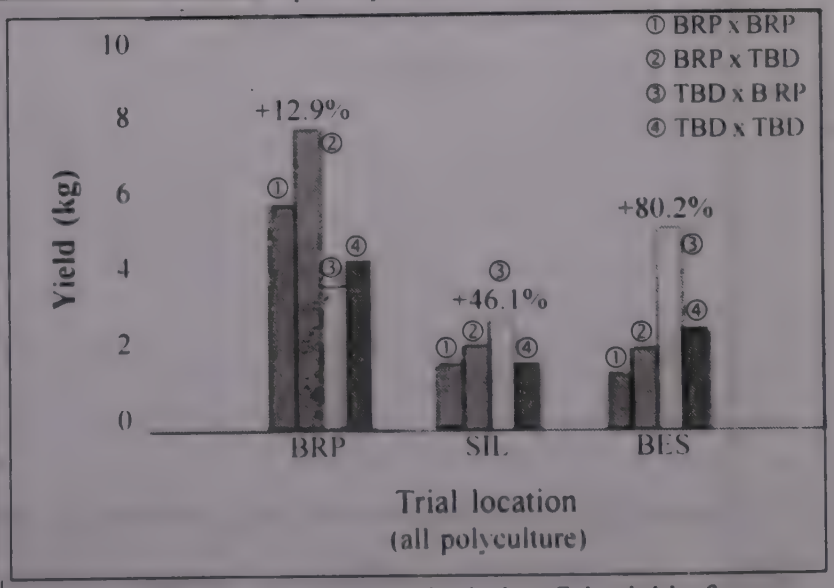

Fig 3 : Catla growth trials depicting fish yield of two crosses and two pure parental stocks during 1998-99. Poly = polyculture (Source Basavaraju *et al.*, 2000).

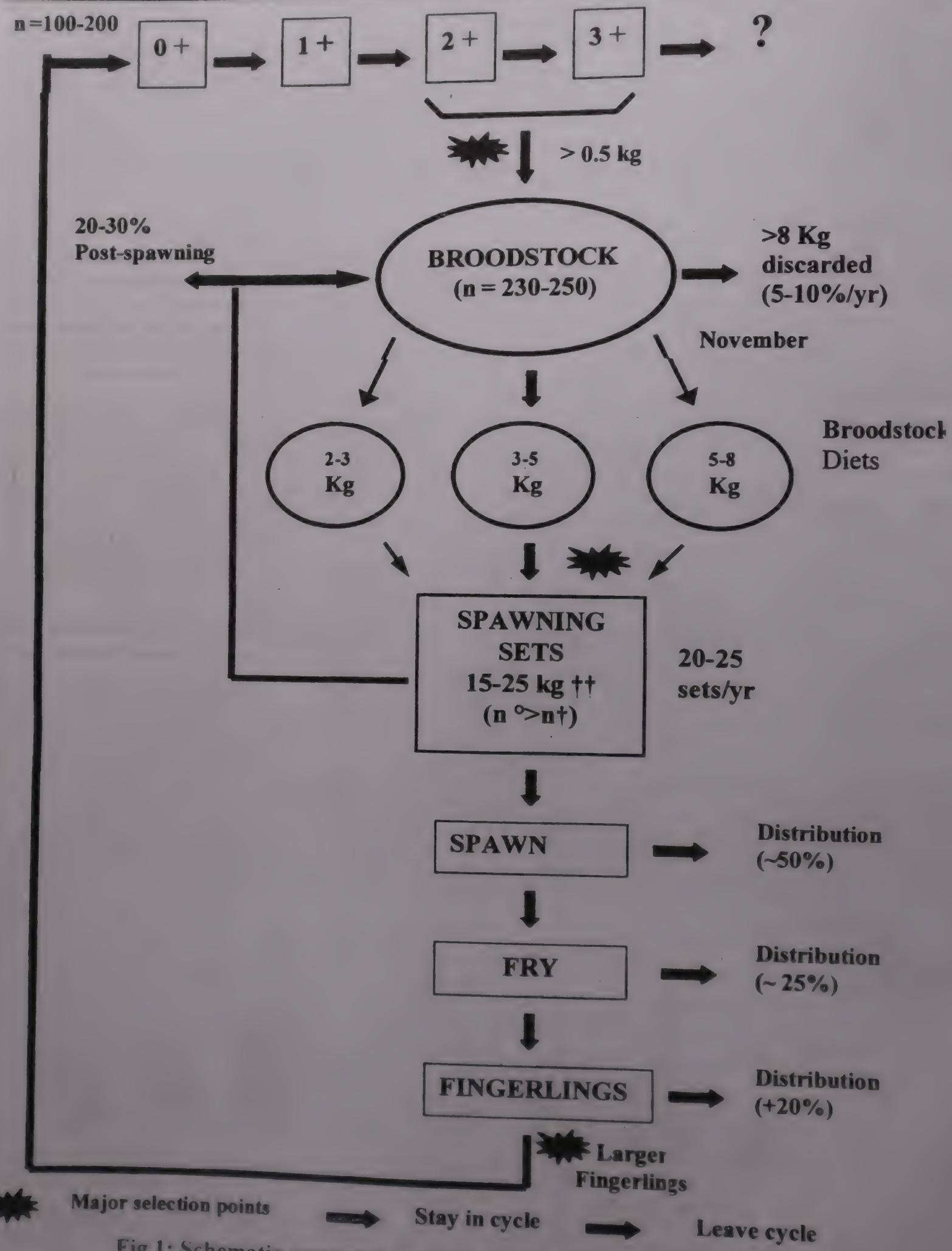

Fig 1: Schematic presentation of "typical" broodstock management in IMC hatcheries in Karnataka

inbred, F1 crosses between them would be expected to show better performances (heterosis).

For these trials, broodstock from RBP and TBD were used. Diallel (2 x 2) crosses were set up to produce BRP x BRP, TBD x TBD, BRP x TBD and TBD x BRP lines. These were grown on to fingerling size (approximately 8 g), marked or tagged so that the four groups could be identified, then grown on in communal stocking under a variety of farming environments and systems (monoculture, polyculture; on-station and on-farm). Data were gathered from these trials during two years, giving a total of six trials. In all cases, the mean yield from the two interhatchery crosses was higher than the mean yield of the two hatchery stocks (Fig 2 and 3). In five out of six cases, the mean yield of the two interhatchery crosses was also higher than the better of the two pure hatchery stocks. These results indicate positive heterosis or "hybrid vigour" which might be expected from crosses between inbred lines. The gain varied from trial to trial, probably reflecting the different environmental condition in these trials, and was composed partly of weight differences and partly of survival differences.

The above findings were discussed in the workshops organised in 1996 and 2000 by the Fisheries Research Station, University of Agricultural Sciences, Bangalore under the DFID-funded Project. The workshops were attended by scientists from different institutes and officials from the DOF and progressive farmers. The second workshop, after detailed deliberations, came out with the following recommendations for the improvement of catla stocks in Karnataka and requested the DOF to implement the recommendations.

RECOMMENDATIONS

1) The Department of Fisheries (DOF) and the University of Agricultural Sciences, Bangalore (UASB) may coordinate the implementation of appropriate broodstock management strategies at the nucleus centres.

2) The Department of Fisheries may initiate from the year 2000 and continue onwards some commercial production of crossbred catla (BRP x TBD) at BRP with assistance from UASB. The DOF may consider recording details of some farmers growing these fish and collect feedback on their culture performance.

In accordance with the above recommendations, steps were taken to : (i) implement the improved broodstock management (broodstock replacement strategy) at the BRP fish farm to prevent further genetic degradation of the existing stocks; and (ii) to produce cross bred catla (inter hatchery crosses) at BRP as a short term measure to benefit from the heterosis observed between the BRP and TBD stocks. These are described in greater detail hereunder.

Broodstock Replacement Strategies

Under existing practices of catla breeding by the DOF the broodstock replacement strategies to replenish the broodstock would come from left over seed/fry after the distribution of seed and coming from only a few spawning sets (Fig 1). Furthermore, out of the number of fish grown for replacement of broodstock, selection is made based on size. It is well established that properly planned selective breeding can improve growth rates but inappropriate selection practices (e.g. selecting larger fish from mixed age batches which may actually be older rather than faster-growing) may have negative effects such as increased rate of inbreeding. Some of the selected ones may be used for late season spawning which can give negative results. The seed are thus being produced on an increasingly larger scale using a limited parent stock consisting of closely related individuals. This increases the possibilities of a narrowed gene pool in the population, resulting in loss of vigour, viability, and fecundity.

It was agreed to implement an improved broodstock management protocols to minimise inbreeding by maintaining as large an effective population size as possible (by maximising the number of fish which actually contribute to the next generation of broodstock). It was decided to implement this scheme only for catla in the first year and to consider expanding this to other species in the light of one year's experience. To achieve this in practice the following steps were taken.

The nursery tanks were prepared, to stock the spawn from a maximum number of spawning sets, prior to initiation of breeding of IMC. Approximately equal numbers of spawn from all the spawning sets were stocked and reared in different nursery ponds up to the fry stage. Fry from four spawning sets (two consecutive spawning dates, with one set from each spawning block) were pooled into each of these tanks to minimise size differences among the pooled fry. In 2001-02 there were ten breeding sets per block, which were bred, spread over approximately six weeks. The fry produced were stocked in the nursery ponds as shown in Table 3. At the end of the spawning season fry from all the spawnng sets were pooled and 250 fry were taken at random to form the 0+ broodstock replacement pond for each block. The fry were selected at random (i.e., no size bias), to maximise the chance of all of the families being represented in the fish used for broodstock replacement. These fish would be marked to identify them to their year class.

Commercial Production of Catla Crossbreeds

As stated earlier, commercial production of catla crossbreeds (intra specific hybrids) was taken up at Bhadra fish farm to benefit from the heterosis observed in the experimental trials. In addition to the crossbreeds, production of catla introduced from a wild population (River Mahandi) was also taken up. While the crossbreds offer short-term gain, it is likely that in the longer term, further genetic improvements will require new broodstock (as well as improved genetic management strategies). The details of catla seed produced in 2001 are presented in Table 4. The widespread distribution of these different catla genotypes will ultimately enable comparative evaluation of their performance in different environments and at different management levels. For this purpose, records of distribution of these

Table 2 : Broodstock replacement strategy applied for catla at BRP in the 2001-breeding season based on recommendations

Batch	Date of spawn lifting	Block 1 production			Block 2 production			Pond no. (total no. of fry stocked)	No. of fingerlings to 0+year broodstock pond
		No. of females	No. of males	No. of fry to be taken	No. of females	No. of males	No. of fry to be taken		
1	26/05/01	2	3	900	1	3	900	1(3,600)	42
2	31/05/01	3	4	900	4	6	900		
3	2/06/01	3	4	900	9	12	900	2(3,600)	42
4	6/06/01	5	8	900	11	15	900		
5	11/06/01	7	13	700	5	8	700	3(2,800)	42
6	16/06/01	7	12	700	10	14	700		
7	20/06/01	4	5	700	5	9	700	4(2,800)	42
8	25/06/01	1	3	700	9	12	700		
9	30/06/01	3	5	500	9	12	500	5(2,000)	42
10	14/07/01	3	5	500	6	10	500		
Total		**38**	**62**		**69**	**92**			**252**

seeds to different growers have been maintained. These places would be visited later for subjective evaluation of cross breeds in comparison with the other catla stocks. Results of this survey would help in taking further decisions.

It is hoped that these measures will help in improving the productivity of this most important carp species and in turn will increase the inland fish production of the State.

Summary

The production of fish seed of good genetic quality requires a good quality founder stock and good genetic management in the hatchery. In this contribution, we have described some of the steps being taken in Karnataka towards this goal for catla. In the longer term, the aim is to have a selective breeding programme starting from the best available founder stocks, but in the shorter term, inter-hatchery crossbreds are being used for immediate genetic improvement while different stocks are evaluated and improvements to hatchery management are implemented.

Table 3: Commercial production of Catla at Bhadra Reservoir Project Fish Farm, Shimoga, during the 2001-spawning season

	Mahanadi catla (Wild)	*BRP Farm stock*	*Crossbred*
No. of spawning sets	5	23	2
Females (N)	45	92	18
Mean W (kg)	4.19	3.63	6.86
Males (N)	51	113	16
Mean Wt (kg)	3.71	3.67	8.25
No. of females spawned	38	72	10
Fecundity (no. of eggs/kg body wt of fish)	1.04.885.32	1.00.232.87	1.04.939.27
Fertilization Rate (%)	89.00	87.25	80.00
Spawning success (%)	84.44	78.26	55.56
Total no. of eggs obtained (In million)	16 70	26.20	7.20
Total Spawn obtained (In millions)	10.48	22.45	2.40
Survival rate from Egg to spawn(%)	62.72	85.68	*41.67

* The lower survival observed in case of the crossbreeds is mainly due to management problems (water supply problem) in one of the batches

Acknowledgements

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Hybridoma Technology-based Farmer level Immunodot Test for Detection of Whitespot Syndrome Virus of Shrimp

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College of Fisheries, Mangalore 575 002

A vast area of 1,50,000 ha has been brought under shrimp culture in India. White spot disease (WSD), caused by whitespot syndrome virus (WSSV), was first reported in shrimp under culture in India in 1994 (Mohan *et al*. 1998). The disease is now widespread in the country (Shankar & Mohan, 1998). The estimated annual loss due to WSD in shrimp culture is around Rs.500 crores.

The virus is not restricted to culture sector alone. It is ubiquitous and widespread in both culture systems and in wild waters. Further, besides cultured tiger shrimp, the virus is reported from a wide range of crustacean hosts that includes various species of shrimp, crabs and freshwater prawn. Zooplankton is also found to be a host to the virus. The virus has been detected in tiger shrimp brooders caught from the wild. There is no successful chemotherapy or vaccine available for management of the WSD.

Under the present scenario, development of strategies to successfully manage shrimp culture in the presence of the virus is the only option available. Presence of the virus among the brooders and post-larvae has been demonstrated to be one of the important risk factors associated with WSD outbreak. Considering this, it is proposed that avoidance of the virus is the best option and this can be excercised by proper screening of brooders and seed. Now, it has been widely accepted that it is the level of virus infection (prevalence and load) in brooders and seed and not the mere presence of the virus which has implications related to success or failure of the crop. Therefore development of simple screening methods, which can detect the high risk level of the virus for successful management of the culture, is important and is the need of the hour.

Available Screening Methods

In general, genome and antibody based diagnostics are used for screening of viruses.

Diagnosis by gene probes : Polymerase chain reaction (PCR) has become a common screening method for screening PL and brooders in India and elsewhere. PCR developed by Lo *et al* (1996) has been demonstrated to detect all isolates of WSSV in Asia. The PCR is a highly sensitive assay which is based on amplification of the existing copies of DNA for easy detection. Further, the test can be performed in 2 steps (1 and 2 steps) to increase the sensitivity. Although the PCR is highly sensitive for the virus detection, there are practical limitations to its widespread application such as need for special equipments, laboratory and well trained personnel, and high cost (Sithigorngul *et el* 2000). Besides, PCR requires more time (7-8 h for 1 step assay) in the laboratory which is also a constraint. The cost of the test which ranges from Rs.300 to 1,000 for 1 step PCR is also prohibitive for poor farmers. Of all the drawbacks, false positive is a difficult problem with PCR (Know & Higuchi, 1989). Surface, passive and cross contamination of WSSV genome is a serious point to be solved in shrimp samples from a WSD endemic areas. Besides, false positives result due to contamination of genome through equipments, reagents, chemicals, personnel etc., and lead to confusion in the validity of the test. As the very assay is based on amplification of DNA for easy detection, any contamination by mistake also amplifies contaminant DNA leading to false positive. False positive and false negative results may be one of the reasons why many a times association between PCR status of the seed and crop outcome in the field are not obtained. When the assay is highly sensitive, complex and prone for contamination, it will become necessary to closely examine whether the existing sampling procedures and the laboratory practice in commercial screening will meet the standard for obtaining consistant and reproducible result.

Furthermore, several studies (Lo *et al*. 1998, Tsai *et al*. 1999) have indicated that 2 step positive results of the highly sensitive nested PCR do not always show association with outbreak of the viral disease in the field and hence has limited value for field prognosis. However, stocking of one-step PCR positive seed has shown strong association with outbreak of WSSV (Withyachumnarnkal, 1999). Besides, in seed screening 1 step PCR results have been found to be more meaningful for screening of shrimp brooders (Hsu *et al*. 1999). Brooders with 1 step PCR positive are always risky with high prevalence in progeny, as against negligible with 2 step PCR risk. Production of WSSV-free or lightly infected Pl from 1 step negative brooders is claimed to be safe.

Our laboratory has employed PCR for detection of WSSV in the farms of Kundapur, Karnataka (Thakur *et al* 2002) for an epidemiological study from 1999-2001. The epidemiological study was carried out using PCR as main tool for screening PL and adults in growout ponds to identify risk factors associated with WSD. Nearly 1,750 samples consisting of PL, adult and carriers were analysed by PCR in a massive project that

involved India, Vietnam and UK with funding support from DFID, United Kingdom. From the studies it was not clear whether 2 step PCR status of PL has any practical relevance to predict outbreak of WSD in the field. The level of virus in PL at best detectable by 1 step PCR may have relevance to outbreak of disease. The high sensitivity of PCR particularly with 2 step is ideal for its use in development of SPF stocks, certification etc.

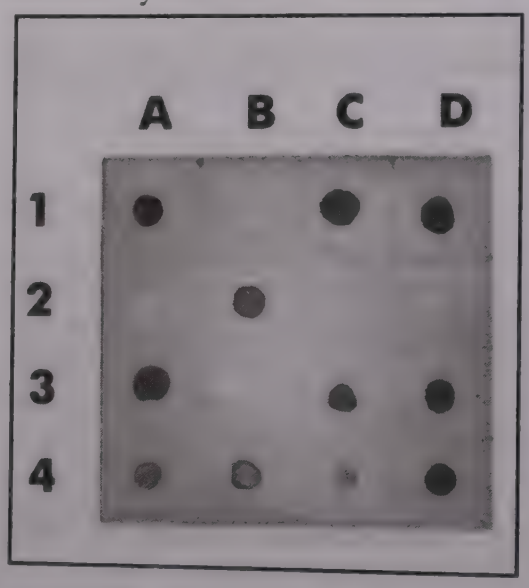
Since WSSV is endemic, the aim should be to exclude brooders and seed with high level of infection from 2 step PCR, as these would require application of less sensitive PCR (1 step) or an alternative screening procedure of similar sensitivity. In this context, it may be mentioned that it is appropriate and essential to develop simple and sensitive monoclonal antibody (MAb) based field level tests for screening shrimp for WSSV.

Diagnosis by Monoclonal antibodies : Antibodies are widely used for specific, rapid and simple detection. Monoclonal antibodies (MAbs) which are produced by hybridoma technology are the preferred antibodies compared to the traditional rabbit antisera (polyclonal antibodies), as they are highly specific at epitope level with no cross or background reaction. The MAbs are sensitive to detect antigen at picogram level and as such scope for false positive is very less as the antibodies detect only the existing quantity of antigen. Further, hybridoma clones are immortal cell lines which can be a permanent source of standard homogeneous antibodies in unlimited quantities. Most important feature of MAbs is the scope they provide for development of a simple, rapid and cheap field level tests such as Immunodot for use by farmers with little training and simple gadgets. Similar tests are already available for detection of microbial pathogens of fish in developed countries.

Development of farmer level MAb-based Immunodot test for screening shrimp for WSSV

The Department of Aquaculture, College of Fisheries, Mangalore has been working on production of MAbs to WSSV for development of diagnostic kits with funding support from the Department of Biotechnology, New Delhi since 1998. A panel of MAbs recognising virus specifically has been produced by hybridoma technology. Employing these MAbs a simple farmer level immunodot test has been developed for screening shrimp for WSSV.

The test involves dotting tissue homogenate from suspected PL/adult on a nitrocellulose paper followed by treatment with MAbs for one hour. After thorough wash, the paper is treated with a second antibody conjugate for one hour followed by addition of a substrate. A



Immunodot test

permanent purple blue dot is developed on the paper within 5-10 min if the sample is positive (Fig 1). At each of the above steps, paper is thoroughly washed with PBS buffer-Tween to ensure removal of unwanted non-specific reactions.

The test is sensitive at 400 picogram level and rapid, requiring only three hours for completion. Farmers can employ this test easily in the field without the need of special equipments or training. The test costs approximately Rs.100 per sample and it is thus cheap. Further, the result can be preserved on the paper and in case of doubt can be mailed to a laboratory for confirmation. Scope for false (false positive) is very less with the immunodot test where actual virus protein copies present in the sample ar detected.

The sensitivity of the dot test ha been further studied in comparison wit that of PCR for screening clinica samples. Interestingly, in our study th limit of detection of the immunodo matches with that of 1 step (Lo *et al* 1996). The test could clearly detect th virus level similar to that of 1 step PC in samples with and without clinica white spot. This finding is very impor tant and has practical application, as i has been demonstrated that 2 step PC results have little relevance to field out break and 1 step PCR is a good predic tor for outbreak of WSD (Lo *et al*. 1998 Tsai *et al*. 1999, Withyachumnarnkal 1999). There exists a strong associa tion between 1 step PCR and outbreak o WSD in the field. In this context, ou immunodot test has more practical rel evance for screening seed and brooders and for prognosis in growout ponds and hence it can be a better alternative to PCR. In shrimp WSD management it is increasingly felt that low load and preva lence of WSSV is no risk, but if detected by a 2 step PCR which has negative prac tical implications, there is a need for de tection of high load and its prevalence for effective and meaningful manage ment of WSSV.

With the presently employed highly sensitive nested PCR screening, more and more PL batches are likely to test positive. This can lead to a scenario where there may not be sufficient PCR negative seed batches left for stocking. As it is well known that only PL batches with high load (1 step positive) or high prevalence are more likely to fail, it is necessary to detect and eliminate PL batches which have high viral load. In this context, MAb based immunodot test having sensitivity equivalent to 1 step PCR can go a long way in achieving this objective. Further work for developing the immunodot test to a field level kit is under progress.

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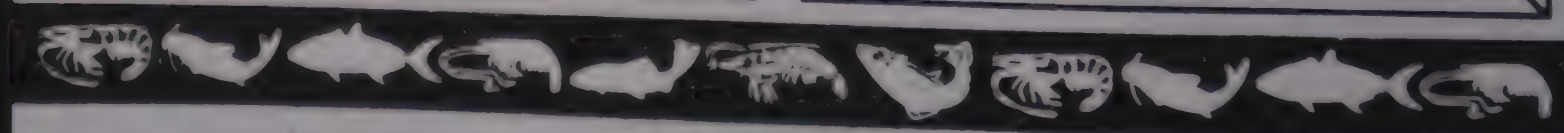

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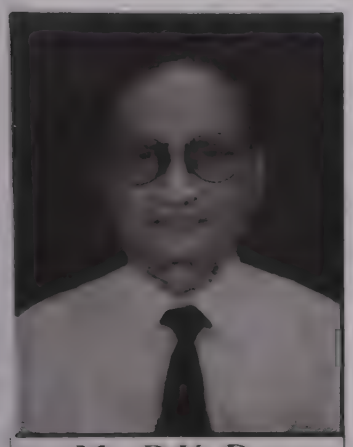

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The West Bengal State Fishermen's Cooperative Federation Ltd. (**BENFISH**), registered (Reg No.15 (Cal)/78) under the West Bengal Cooperative Act & Rules, was established in the year 1978 as the Apex body of the Fishermen's Cooperatives in the State.

BENFISH Bhavan

It has a membership of 154 with paid-up Share Capital of Rs. 25 crores. The objectives of **BENFISH** are i) augmenting fish production by infusing scientific methods of pisciculture, and ii) uplifting of socio-economic conditions of fishermen by introducing modern crafts and gears.

BENFISH is a state level fishermen's cooperative being managed by a Board of Directors headed by Mr. Kiranmoy Nanda, Minister in charge of fisheries, Government of West Bengal as its chairman. By dint of efficient management, the Directors of **BENFISH** have been able to increase fish production and also improve the socio-economic conditions of fishermen in the State to a considerable extent. **BENFISH** now provides employment to 150 regular and 20 contract service staff, 18 sales girls and 10 deputed officers. Besides these, **BENFISH** has been able to create employment opportunities approximately to 20,000 fishermen as harvesters and 15,000 fishermen as commission agents for marketing of the catches and other fish products.

Some of the major activities of **BENFISH** and its achievements till end of March 2001 are outlined hereunder.

The West Bengal Integrated Fisheries Development Project

This project is being implemented by **BENFISH**, phasewise, with financial assistance provided by the N.C.D.C. Under this project, **BENFISH** has already constructed and distributed 750 nos. of mechanised fishing boats fitted with 4 & 6 cylinder engines amongst 750 nos. of Fishermen Groups of Marine Primary fishermen's Cooperatives of sea-going Fishermen of the State in the following phases.

1st Phase	200 nos.
2nd Phase	50 nos.
3rd Phase	100 nos.
3rd Phase (Extn)	100 nos.
4th Phase	300 nos.
5th Phase for (2002-2003) mech boats to be supplied	200 nos.

Besides these boats, **BENFISH** has set up 20 ice plants, one cold storage, and one boat repairing yard at Frasergunj Fishing Harbour Complex under this project. An amount of Rs.38.35 crores has been spent for the purpose.

Encouraged by the progress of work under the West Bengal Integrated Marine Fisheries Development Project upto Phase-4 and considering the demand from the sea going fishermen, of both Midnapore and South 24-Parganas districts, for mechanised fishing boats, **BENFISH** has submitted the Vth Phase of the project to N.C.D.C. for a loan of Rs.30 crores for construction of a new batch of 200 mechanised fishing boats under the said project, during the year 2002-2003. This project will help in increasing the fish catches to an estimated 7,000-10,000 mt. per annum, directly benefiting 5000 nos. of sea-going fishermen of this area under this project. Besides, 3.00 lakh mandays of employment will be created by different activities of the project.

A haul of fish under Integrated Brackishwater Aquaculture Development Project at Nayachar

Beel Fisheries Development Project

In order to increase fish production in the extensive inland water areas, namely *Beels* in different districts of the State of West Bengal, **BENFISH** has

started implementation of this project keeping in view a target of 87 *beels* and *boars* to be brought under this project in seven districts namely North 24-Parganas, Nadia, Murshidabad, Maldah, North Dinajpur, South Dinajpur & Hooghly. **BENFISH** has earlier been able to bring 72 *beels* and *boars* covering 3484 ha. of water area under this project with the financial assistance of N.C.D.C and has been able to utilise an amount of Rs.435.59 lakhs out of the sanctioned amount of Rs.536.00 lakhs.

In this connection it may be stated that most of the big water areas are vested in the State and the State Government in turn has leased out the said water areas to the Fishermen's Cooperatives Societies as a matter of policy. Unfortunately, most of the leased out extensive water areas are in derelict/semi-derelict condition due to soil erosion of marginal lands, and weed infestation followed by resultant decomposition and wanton neglect of the areas over the years. The Fishermen's Cooperative Societies that are functioning in a chief managerial capacity do not have affordable funds to take up necessary developmental works such as deweeding, desilting, re-excavation etc., of the said derelict/semi-derelict water bodies. As a consequece, there has been a gradual shrinkage of the effective water bodies ultimately hampering fisheries activities and fish production. In a bid to find a solution to this gloomy picture, a new proposal was initiated with the N.C.D.C for culture fishery development of these waters. The estimated cost of the project which is Rs.271.61 lakhs for development of 1500 ha of such water areas in the selected *beels* and *boars* of Nadia and North 24-Parganas districts has already been sanctioned for undertaking necessary reclamation and other major developmental works. It is expected that after implementation of the project fish production will be enhanced from 200 to 500 kg per ha per annum.

'Ganga Bhawan' Diamond Harbour

Bundh/Reservoir Fisheries Development Project in Bankura and Purulia Districts

With the aim of introducing scientific fish culture in the *Bundhs*/Reservoirs in the districts of Bankura & Purulia, **BENFISH** has started implementation of this project with financial assistance of NCDC. A total of 47 *Bundhs*/reservoirs covering 8785 ha of water areas held by 57 Primary Fishermen's Cooperative Societies are to be brought under this project. Till now 47 *Bundhs*/Reservoirs covering 8785 ha. of water areas have already been brought under this project. The rate of production per ha has been increased to about 800 kg from the earlier average of 200 kg.

Brackishwater Aquaculture Development Project at Nayachar Island

With a view to augmenting production of Brackishwater shrimp in the State, **BENFISH** has undertaken the work for implementation of the said project at Nayachar Island in Midnapore district with the financial assistance of the NCDC. The capital investment part of this project is Rs. 16.95 crores. The National Building Construction Corporation (a Govt. of India Enterprise) has been entrusted with the constructional work of the 250 ha. brackishwater farm at the Island. The construction of the farm is likely to be completed shortly. An amount of Rs.15.80 crores has already been spent under the project.

Common Facilities Centre

For processing marine products in a hygienic condition conforming to internationally accepted standards, **BENFISH** would be setting up a Common Facility Centre at Chakgaria in South 24-Parganas district with the financial assistance of the NCDC and the Union Department Food & Processing Industries, Govt. of India. The project includes the construction of 10 processing units, cold storage, ice plants and other modern infrastructural facilities. The total project cost is around Rs.17 crores. The production will be about 45.000 mt. of frozen shrimps per annum. Besides being a financially viable project, it will also create employment opportunities to 195 skilled and 725 unskilled labourers indirectly.

Marketing of Raw and Processed Fish

BENFISH has set up a modern fish processing centre at Salt Lake, Kolkata, equipped with plate freezer, cold room, and fish drying machines for processing of raw shrimp and fishes and also for preparation of various fried fish products. For sale of these fish and fish products, **BENFISH** has 8 mobile vans and 22 nos. of retail marketing outlets in New Delhi, Darjeeling, Siliguri, Coochbehar, Haldia and at some other places. More over, **BENFISH** opens stalls in various fairs organised at different places of West Bengal and even in New Delhi. **BENFISH** has been able to sell raw fish and processed fish amounting to around Rs. 1.5 crores/year.

BENFISH in Tourism

To meet the growing demand of the tourists, **BENFISH** has set up tourist lodges in different places of tourist interest namely, Fraserganj and Diamond Harbour (in South 24-Parganas), Sankarpur & Digha (in Midnapore), Darjeeling (in Darjeeling), Puri (Orissa) &, Kumlai in Jalpaiguri district with

boarding facilities. Besides, **BENFISH** has decided to set up one Guest House in Chennai.

Welfare Scheme for Fishermen

Fishermen's Group Personal Accident Insurance Scheme for Active Fishermen : The fishing profession is ridden with hazards. Fishermen are prone to accidents while on fishing voyages, which may entail risk of loss of lives, disability, vessels drifting astray etc. For providing financial relief to the distressed families of fishermen, **BENFISH** has been implementing the centrally sponsored Fishermen's Group Personal Accident Insurance Scheme since 1984-85. Under this scheme about 60,000 nos. of active fishermen of the State have been brought under the insurance coverage during 2000-2001 and an amount of Rs.13,65,000/- has been paid to 572 nos. of fisher families upto March 2001.

Centrally sponsored Saving-cum-Relief Scheme for the Marine Fishermen : Most of the fishermen engaged in sea fishing are members of poor fisher community. During the peak fishing season lasting from July to February, usually they earn adequate money for their needs but due to spendthriftiness they run into great distress during the lean fishing period (i.e., from March to June). Considering this appalling position, **BENFISH** is implementing the centrally sponsored Saving-cum-Relief Scheme for the marine fishermen for partial redressal of hardships which the fishermen are usually confronted with during the lean fishing period.

In this scheme the selected fishermen shall have to deposit Rs.45/- per head per month from July to February as their monthly savings contribution to **BENFISH**. The State and Central Government will also contribute an equal sum of Rs.45/- for each of the selected fishermen for the said purpose. From March to June **BENFISH** will pay @ Rs.270/- to the respective fishermen per month for four months.

During 1998-99 a fund was created with Rs.54.00 lakhs out of which payments have been made to 5000 no. of fishermen under the scheme.

BENFISH has created its own fund for providing financial assistance for the welfare the fishermen in the form of grants. Until now, **BENFISH** has provided Rs.87,950/- to 72 nos. of children belonging to fisher families with a view to providing financial relief towards their educational expenditure. **BENFISH** has also paid Rs.1,31,025/- for treatment of 10 fishermen of the State and also cyclone affected fishermen of Orissa. Besides, **BENFISH** has been able to reserve one bed at Thakurpukur Cancer Centre and Welfare Home for the treatment of poor fishermen.

Training Scheme of BENFISH

BENFISH has opened a training cell for imparting training and education to the members/officials of Fishermen's Cooperatives under different NCDC assisted projects. During the year 2000-2001 and 2001-2002, a total no. of 443 and 549 beneficiaries respectively undertook training.

Development of Marine Fish Production & Processing in Midnapore East District : **BENFISH** has already started implementation of the project for the Development of Marine Fish Production and Processing in Midnapore East District during the year 2001-2002 and a sum of Rs.962.03 lakhs has been sanctioned by NCDC for the purpose.

Projects awaiting Sanction from the NCDC

Extension of Brackishwater Aquaculture Development Project at Nayachar Island : Being encouraged by the progress of NCDC-assisted Brackish water Aquaculture Development Project at Nayachar Island and considering the growing demand from the Fishermen's Cooperative Societies working on Brackishwater Fish Culture around Nayachar Island for extending the project and the infrastructure facilities already created for implementation of on-going Brackishwater Project at the Island, **BENFISH** has submitted a proposal for extension of the project for bringing a further area of one hundred ha under brackishwater aquaculture. The estimated total project cost is Rs.97.00 lakhs. It is expected that 250 mt. of brackishwater shrimp and freshwater prawn will be produced under this extension project.

Fish Preservation, Processing & Marketing : In order to achieve higher production of dry fish and fish meal by utilising marine trash fishes for domestic as well as foreigh market, **BENFISH** has been contemplating to take up the above project. Under the project salted/dry fish will also be produced. A regulated dry fish market, 2 cold storages, 9 Ice plants will also be set up. The estimated project cost is Rs.547.67 lakhs.

Project for Crab Culture in Sundarban Area : A project on crab culture at a cost of Rs.96 lakhs for augumenting crab production in the State has been submitted to NCDC for approval and sanction during the current financial year.

Project on Ornamental Fish Culture for Women's Cooperatives : A project on ornamental fish breeding and culture at a cost of Rs. 5 crores for the welfare of womenfolk in the districts of Howrah and South 24-Parganas has been submitted to NCDC for approval and sanction.

Workshop on Life History Traits of Freshwater Fish Population

NBFGR, Lucknow: June 6, 2002

The workshop on the above captioned subject would be held on June 6, 2002 in Lucknow. Those interested in contributing papers for presentation at the workshop may send abstracts to Dr. D. Kapoor, Director, National Bureau of Fish Genetic Resources, Canal Ring Road, P.O. Dilkusha, Lucknow-226 002 by May 20, 2002. The Abstract may be prepared using word processor of MS Word and floppy may be sent along with two hard copies. The abstracts can also be sent by email to nbfgr@sancharnet.in as file attachment. All abstracts relevant to the theme will be published as part of the proceedings.

Fisheries Pathshala in the Courtyard of Aquafarmers

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Central Institute of Fisheries Education
Lucknow Centre, Chinhat, Lucknow - 227105.

For the real benefit of aqua-farmers, at their own place, a week long Fisheries *Pathasala* was organised by the scientists of CIFE, Lucknow Centre at Mahura Khurd village from November 26 to December 2, 2001. This programme was conducted in a fashion similar to ancient Indian tradition of Gurukula. Generally short term programmes for fish farmers are traditionally conducted within the campus of institutes and its training centres. This innovative programme was indeed a refreshing change, proving to be effective in identifying and solving the problems of aqua-farmers. Probably the effectiveness of this programme was due to close interactions between resource persons and the selected farmers at the place of avocation of these farmers. The CIFE team responsible to conduct the programme could identify and solve the problems of pond culture on the basis of their own knowledge and experience with the support of minute descriptions given by the farmers. A wall-to-wall poster and herbarium exhibition was also set up as part of the *pathasala* which was unique in the sense that it was in complete synchronization with the course contents of the *pathasala* and level of understanding of participants.

The original theme idea of conducting this Fisheries *Pathasala* was conceived by the course coordinator, Dr.Alok K.Jain, Scientist (S.S.) and as a follow-up, initiative was taken by him in translating it into action, well supported by Dr.S.Ayyappan, Director, CIFE. The objectives of conducting the *pathasala* were: to educate the village folk on benefits of fish culture, utilisation of water bodies for fish culture, teaching scientific methods of fish culture in village ponds, solving the common problems of those aqua-farmers who are utilising some of the available ponds with conventional methods, and finally generate interest and awareness about pisciculture among the folks of target and nearby areas of Mahura Khurd.

The Fisheries *Pathasala* was inaugurated by Gram Pradhan, Mr. Harinam Singh at Mahura Khurd block Office, Gosainganj in district Lucknow on 26th November, 2001. Message of the Director, CIFE, Dr. S.Ayyappan was read out by the Programme Coordinator at the inaugural function. During the *pathasala* schedule, enthusiasm of all the thirty two participants rose to its peak. The theme of this first fisheries *pathasala* was Management of Fish Culture in village ponds. During the programme various aspects of fish culture such as culture and management of village ponds, food and feeding habits of culturable carp species suitable for village ponds, composite fish culture, pond productivity, natural and supplementary fish feed, production economics, importance of physico-chemical parameters of pond water, etc., were taught in easily assimilable mode. The applied aspects based on these topics were also demonstrated, besides visits to four ponds for diagnosis and treatment advice. The *pathasala* has conducted with the active involvement of Dr. P. M. Sherry, Scientist (S.S.), Dr.Z.J. Abidi, Technical Officer, Mr. Sanjay Singh, Technical Assistant, and Mr. P.C.Verma, Junior Clerk. Mr. Narayan and Mr. Ram Lakhan, both supported the team very well. The programme came to an end on December 2, 2001 with distribution of certificates from CIFE to all the participants by Gram Pramukh of Mahura Khurd. The beneficial effects of the First Fisheries *Pathasala* could soon be seen in the optimum utilisation of human and water resources and implementation of modern techniques of fish culture by the people of that village.

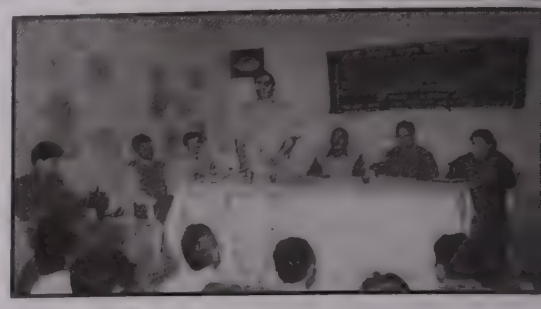

Fig 1: Inauguration of Fisheries *Pathshala*

Fig 2: Exhibition for setting of *Pathshala*

Fig 3: Classroom Practical Activity

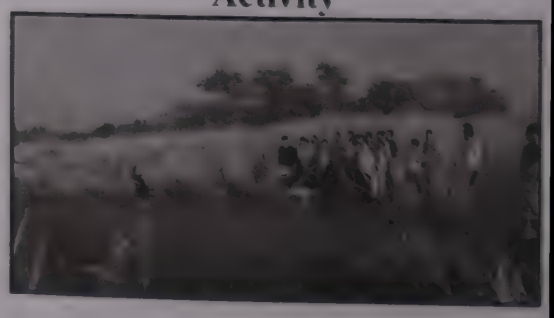

Fig 4: *In situ* field demonstration

Fig 5: Team with participants

..Towards Conservation and Sustainable Commercial Utilisation of Fish Genetic Biodiversity of India

NBFGR's Contribution

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India is endowed with a rich fish genetic biodiversity and it ranks 9th among countries with freshwater megabiodiversity. This status is somewhat blurred by anthropogenic interventions mostly owing to urbanisation, damming of rivers, and abstraction of water for irrigation and power generation causing environmental degradation. Pollution has in the last few decades subjected our natural waters in general and rivers in particular to severe stress with devastating effects on freshwater fish genetic biodiversity. This has been aggravated by irreversible genetic changes in natural populations because of introduction of exotic species, diseases and predators. The loss of biodiversity is perceived as loss of some populations within a species or the complete extinction of a species.

The aquatic germplasm resources of India are diverse and they constitute an important component of food security. For sustainably increasing fish production, improvement and expansion of capture fisheries and enhancement of aquaculture production alone are not sufficient. Conservation of the diversity of fish germplasm is a necessary prerequisite in this regard. The conservation of the aquatic genetic resources and their habitat can greatly contribute towards uplifting the socio-economic structure of India. Looked at in retrospect, taking into consideration the rapidly changing world scenario after the signing of the Convention of Biological Diversity, the establishment of the National Bureau of Fish Genetic Resources (NBFGR) under Indian Council of Agricultural Research, New Delhi was a farsighted and planned initiative. The NBFGR was instituted in December, 1983 and since its inception, the Bureau was dependent on rented accommodation. Now it has its own building, farm complexes located at Canal Ring Road, Lucknow-226 002, U.P. Within a short span of its establishment, NBFGR has emerged as a pioneering research institution of the country in the field of *in situ* and *ex situ* conservation of fish biodiversity. Moreover, NBFGR is the only Institute in this part of the World which is carrying out research on all aspects of fish germplasm conservation and cataloguing.

Mandates of NBFGR

The mandate has the following components : a) Collection, classification and evaluation of information on fish genetic resources; b) Cataloguing of fish genotypes; c) Maintenance and preservation of fish germplasm; and d) Monitoring the introduction of exotic fish species into the country.

Achievements through Research

Development of fish biodiversity database: In pursuance of its mandate on cataloguing of fish genetic resources of India, the Bureau has been constantly striving to build a rich store house of knowledge on fish biodiversity. Database on fish genetic resources is essential for undertaking a programme on conservation of fish germplasm and long-term sustainable exploitation of fish resources. The design of Fish Biodiversity Database of India was modified by adding primary and foreign keys for querying and establishing relation with the external or internal tables designed. Existing database tables were normalised which resulted in increased performance of database in terms of accessing, querying, searching and updating of information. Synonyms and fin formulae of fishes were included in fish database. The database was updated by adding relevant features like fin formula, synonyms of fishes and images of 436 fishes along with their distribution. Data on marine shellfishes of India (crustaceans and molluscs), marine reptiles (turtles and crocodiles) and marine mammals (whales and dolphins) were also added to the database. From the Fish Genetic Biodiversity database, it is possible now to retrieve specific information on the aquarium fishes and aquaculture species from fresh, brackish and marine waters. On drainage maps of Kumaon area in U.P. hills, information on endangered mahseer with regard to breeding grounds, migration routes, availability of broodstocks, deep pools and areas where destructive fishing was being done has been superimposed. For two rivers of Kerala, location specific species listing along with their conservation status and endemicity were added in the database.

Utilising IUCN criteria, 329 freshwater fishes were assessed by experts in a five day 'Freshwater fish Conservation Assessment and Management Plan (CAMP) Workshop. A consolidated list of 287 primary freshwater fishes of Western Ghats was prepared of which 192 (67%) were found to be endemic. Of these, 153 fish species were identified as potential ornamental, cultivable, food and sport fishes endemic to Western Ghats.

As part of water bodies database, the digital base maps of India showing about 330 rivers and lakes have been extracted from Survey of India maps. Seven base maps of India at the scale of 1:2,50,000 were prepared and georeferenced to single coordinate system and datum. By using these digital base maps and com-

bining these with database on Geographic Information System (GIS) platform, the information on fish distribution of India can be arranged state wise, drainage wise and region wise. Further, fish distribution data can be correlated with spatial information on climatic and physiographic parameters.

Exotics and quarantine

Issues related to exotic fishes and quarantine occupy a prominent place in the fishery development programmes of a large country like India. Since monosex population can be used to achieve higher production levels in species where one sex grows larger in size or where prolific pond breeding adversely affects growth, the technique for production of monosex population has been perfected with tilapia. The incidence and intensity of parasites in native *Clarias batrachus* and exotic *C. gariepinus* were studied up to generic level. Cell culture facilities were established and diagnostic kits for some OIE listed diseases exotic to India were obtained. As a lead centre, Aquatic Animal Pathogen and Quarantine Information System (AAPQIS) database was consolidated and work on pathologists directory and preparation of NBFGR fish quarantine database has been initiated. As the nodal agency in India, 146 records were entered in the Aquatic Animal Pathogens and Quarantine Information system of the Network of Aquaculture Centers in Asia-Pacific (NACA), FAO. Under Quarantine database 568 AAPQIS entry forms were filled and in the Indian Fish Pathologists Directory (IFPD) 49 entries were made in the proforma prepared at NBFGR. A separate bibliographic database named 'Disease base' was also prepared.

In consultation with other ICAR fishery institutes and other stakeholders, amendments were suggested in 'Livestock Importation Act' to incorporate provisions for aquatic organisms quarantine for the first time. As per directions from Ministry of Agriculture, the 'National Strategic Plan on Exotic and Quarantine of Aquatic Animals' was prepared and submitted to the Ministry. Under maintenance of fish cell lines for screening viruses in suspected diseased samples, revival of cell lines BF-2 and FHM was done successfully after 6 month storage at -70° C. A small animal maintenance facility was developed where rabbits are being reared for use in the production of antisera against fish pathogens and antifish antibodies.

Under its programme of monitoring the introduction and spread of exotic fish species in Indian waters, the spread of exotic fish species - bighead carp and exotic magur has been documented in collaboration with UP State Fisheries Department under intimation to the Ministry of Agriculture. Information on the spread and culture of exotic magur from Varanasi and Lucknow was collected. *C. gariepinus* collected from Varanasi and gold fish and tiger fish collected from Lucknow were screened for parasitic infection. Bacteria and microspora were observed. Pathological problems in *C. gariepinus* were identified from survey. These are related to slimy disease, dropsy, ulcerative disease syndrome, anorexic syndrome and gastrointestinal blockage. Under the effort to evaluate the ecological impact of *C. gariepinus*, information on the local related species *C. batrachus* was collected.

Geographic Information System

The GIS and remote sensing tools have become very important for studying natural resources. In India, the application of this technique is limited only to marine and lake systems. This has to be extended to fluviatile systems such as streams and rivers, as it is also very essential to develop methodology for applying these techniques to these flowing waters with reference to endangered fish habitat. On this new technique, various studies were made at NBFGR. The riparian zone of the river Gomti was studied adopting this technique and the path changes were detected (using GIS-remote sensing techniques). The GIS map of Ladhiya stream has shown a different micro habitat features. The different zones of the Kosi river were classified as per the stream reach (uniform zones) type classification suggested by Rosgen (1994). The following GIS maps were prepared for the Kosi river :

- Watershed area and drainage of the Kumaon region;
- Watershed and sub watershed area of the Kosi river;
- Prepared zones and the identified area of the Kosi river; and
- The sampling points during the survey.

The digital base map of India showing about 330 Indian rivers and 20 lakes and reservoirs has been prepared. Almost all the rivers are assigned with their names and a separate ID number has been assigned to each of the river systems in their entirety. The other information about rivers was put in the database associated with the GIS maps. Vectorised wetland maps of Maharashtra State were also made showing area, position, stream habitat and district boundaries. The digital habitat map of Kosi river was prepared indicating optimum and degraded habitat keeping in view the habitat requirements of the endangered fish *Tor putitora*. All the information was collected from IRS 1C satellite imagery, Survey of India (SOI) toposheets and field survey. Physical habitat condition of the Kali river was evaluated by pre-field study using satellite imagery, SOI toposheet maps and habitat data collection in field. All informations were arranged on GIS map. In continuation of the work on reviewing the existing legal instruments related to fish biodiversity of India, State Fisheries Acts of 13 States were examined with regard to the provisions made for conservation of aquatic resources.

Genetic Characterisation

Knowledge regarding the population structure of Indian fish species is limited, mainly due to lack of information on suitable genetic markers. The genetic markers are useful for identification of different stocks and marker-assisted selection and genetic improvement. Biological information about different fish species, though necessary, is not sufficient for undertaking conservation and

genetic upgradation programmes. It is here that basic information on population genetics of prioritised endangered and wild stocks of commercial species is required. Towards this goal, the Bureau has developed a number of genetic markers and determined genetic variation not only among different species but also within different species. The chromosomal banding techniques of NOR and C-banding have been developed. So far, NORs have been detected in 18 different endangered and commercial species of fishes. The number of NOR bearing chromosomes varied between one to five in the species studied, which depict a species specific pattern. Indications of NOR polymorphism have been obtained in two different populations of *Tor putitora*. Karyotyping and NOR of *Heteropneustes fossilis* collected at Lucknow and Assam was done. The results showed no major differences between these two populations. NOR-band in *H. fossilis*, collected from north-east and local populations were studied. The results showed that NOR-bands were present only on one pair of submetacentric chromosomes of both the populations. The results revealed that both the populations of *H. fossilis* were the same.

Baseline value of sister chromatid exchange (SCE) in *Channa punctatus* has been determined. Biochemical genetic characterisation using 25 enzyme systems and isoelectric focusing (IEF) of eye lens and haemoglobin has been carried out in 15 prioritised commercial and endangered species.

Population genetic studies presently being carried out indicate genetic variation in isozyme and IEF markers for rohu and the endangered golden mahseer and hilsa. Allozyme, mtDNA ARFLP and heamoglobin IEF markers capable of detecting introgression between exotic *Clarias gariepinus* and endemic *C. batrachus*, have been developed. Illegally introduced *C. gariepinus* stocks in India were found to be genetically similar to those from Thailand and no intermediate sample was detected on the basis of allozyme and mtDNA ARFLP markers. Genetic introgression of farmed common carp stocks of Himachal Pradesh with gold fish genome has been detected using isozyme genetic markers. With the developed 8 species- specific genetic markers, genetic introgression has been quantified in hatchery stocks of Indian major carps. A cost effective package has been developed which can provide vital information on introgression levels and help to maintain pure broodstocks. Species specific mtDNA ARFLP markers in Indian major carps have also been identified, which can provide additional information on introgression in these species. Under the collaborative programme with CIFA, the six founder stocks used in selection programme have been characterized genetically and the extent of genetic variability has been quantified. The genetic marking of threatened marine fishes *Tachysurus maculatus* and *T. subrostratus* has also been carried out in order to resolve taxonomic ambiguity.

Population genetic studies of the endangered marine fish *Lactarius lactarius* were conducted. Stock structure analysis in respect of east and west coast of India using allozymes and RAPD indicated differences in stock which require different strategies. Freshwater fish from Western Ghat *Labeo dussumieri* and *Horabagrus brachysoma* have been worked out with isozyme markers. Under the collaborative programme with Central Inland Capture Fisheries Research Institute (CICFRI), characterisation of *Tenualosa ilisha* stocks revealed that stocks of *T.ilisha* are related to different geographic locations. Investigations on mitochondrial DNA in Indian major carps using standardized PCR techniques have revealed polymorphism. Population studies in rohu with allozyme analysis of wild populations indicated the existence of at least six distinct stocks viz., Satluj, Ghaggar, Ganga, Rapti, Mahanadi and Brahmaputra. Rohu of Govind Sagar lake was genetically similar to Ghaggar stock, though the lake is connected to river Satluj. Notwithstanding the absence of DNA sequence data of rohu, successful cross amplification of microsatellites in rohu was achieved using primer sequence data from catla. Polymorphic DNA microsatellites and random amplified polymorphic DNA (RAPD) have been identified in natural populations of rohu.

Gene Banking and Cryopreservation

Gene banking is a powerful *ex situ* conservation tool for preserving natural genetic variability in fish at inter as well as at intra-specific level. This conservation strategy has been an important component of NBFGR's research programmes. The Bureau has developed and standardised the technique for cryopreservation of fish milt. Sperm cryopreservation protocols for twelve prioritised endangered and cultivated freshwater finfishes have been developed.The captive breeding and cryopreservation of milt of endangered and endemic fish, *Horabagrus brachysoma* and *Labeo dussumieri* were carried out. Based on motility value and percentage fertilization, three extenders for cryopreservation of *H. brachysoma* were short listed. With *Labeo dussumieri*, successful domestication as well as validation of earlier standardised cryopreservation protocols was carried out. Our studies have facilitated adding two more endangered species from Western Ghats to our gene bank. A mini gene bank with milt of *Catla catla, Labeo rohita, Cirrhinus mrigala, Cyprinus carpio, T. putitora, T. khudree* and *Tenualosa ilisha* has been established

The efficiency of cryopreserved milt for commercial seed production of *Labeo rohita* was tested in farm conditions when oozing males were not available. Mean percentage hatching using cryopreserved milt in late breeding season did not differ significantly from that obtained using fresh milt during the peak season. This validates that cryopreserved milt can be an effective tool for prolonging breeding period beyond normal breeding season. It also indicates the commercial potential of the technique especially during periods of inadequate milt availability. To preserve natural genetic variability, sperm bank accessions from wild stocks were made for IMC from Gomti and Satluj rivers and

for endangered fish *Labeo dussumieri* from Meenachil river.

Under NATP. programme on building tissue repository and collection of accessions was initiated. The DNA yield was greater with liver and gills as compared to other tissues. The best results were observed in samples stored in DMSO at room temperature. The DNA was successfully isolated from cryopreserved spermatozoa of *Labeo dussumieri* and *L. rohita*.

In-situ Conservation

Conservation of endangered fishes in their natural habitat is the best option available for their protection. In India *in situ* conservation, especially of aquatic resources, is still in its infancy. *In situ* conservation requires location and species-specific strategies, which are based on detailed field information. Realising this, a comprehensive list of rivers/ streams harbouring mahseer, an endangered fish in north-east region of the country, has been prepared. Work on fish germplasm inventory of the major drainages and the status of fishery and habitat parameters has been carried out in eight north-eastern states. In order to conserve endangered mahseer and other threatened fishes in Kumaon Himalayan rivers and streams, a biological inventory was carried out in Kali and Gomti rivers. The major areas covered under the inventory include, fish biodiversity and abundance, species composition, and distribution and habitat utilization by various life stages of endangered *Tor putitora*.

To develop *in situ* methodology for conservation of mahseer in hills of Uttar Pradesh, a pilot scale project has been successfully carried out in Ladhiya stream. Formation of 'Mahseer Bachao Gosthi' involving local community, has yielded promising results. Ranching of mahseer has also been successfully carried out. The life history traits of endangered *T. putitora*, which include food spectrum of different life stages, reproductive behaviour and histological aspects, have been studied. Induced breeding of endangered mahseer *T. putitora* was successfully achieved in a UP state farm at Dehradun which is located outside the breeding range of *T. putitora*. Socio-economic aspects of conservation and the role of anglers have also been evaluated in selected areas for exploring possibility of community participation. Since the pattern and regulation of fishing have a great bearing on the fish population dynamics in the streams, detailed information on fishing methods in operation in Kumaon region has been documented. Fish and habitat diversity, abundance, distribution and availability of brood fish of endangered mahseer (*Tor putitora*) in the Kumaon region has been documented. Microhabitat inventories of Ladhiya and Kosi streams have been completed. Fish abundance, distribution and habitat diversity have been documented in two different kinds of stream habitats in UP hills (Kali, and Gomti and Sarju). As per the suggestion of NBFGR's Research Advisory Committee, pesticide contamination levels in hill stream waters and fishes of UP have been determined.

As a measure of repopulating vulnerable carp *Labeo dyocheilus*, in streams, induced breeding was successfully carried out for the first time in Kosi river in Corbett National Park. The experiment was highly successful with 80-95% fertilization and hatching rate of 20 to 95 % under different incubation conditions.

Aquatic Sanctuaries

In order to evaluate potential of freshwater sanctuaries for conservation of endangered fishes, germplasm and habitat inventories were made in two wildlife protected areas - Katraniaghat Wildlife Sanctuary (KWS) and Samaspur Bird Sanctuary (SBS) in Uttar Pradesh (UP). The information on the fish genetic resources, habitat parameters and socio-economic data were collected using GPS. The monthly experimental fishing indicated availability of endangered fishes like *Notopterus chitala* and *Ompok pabda* along with Indian Major Carps. A total of 57 species representing 7 orders, 18 families and 40 genera were recorded from waterbodies of KW whereas in SBS, 39 species belonging t 9 orders, 12 families and 26 genera wer recorded. New record with respect t maximum size of fish was recorded fo *Gudusia chapra* in SBS and for *Barilii tileo* in KWS. This indicates possibilit of emergence of more new records fo other species also from these protecte areas. A large number of species identi fied as threatened by the Conservatio Assessment and Management Pla Workshop of 1997 were found in bot the sanctuaries. The above two observa tions justify the development of fresh water bodies within wildlife sanctuarie as freshwater sanctuaries to save endan gered fishes. Remote sensing image and SOI toposheets of the above sanctu aries were also collected. Database wa modified to the normalised form for suit ability into GIS format for integration

In a similar study under a collabora tive work, one hundred fishermen in fou coastal villages in the Gulf of Manna (GOM) region reported encounterin marine mammals and turtles in their net for 4 to 6 times a month. A brainstorm ing session organised at Tuticorin mad 21 key recommendations for conserva tion of coral reefs, sea turtles, dolphins sacred chank, marine ornamental fishe and sea cucumbers of GOM. A fisher men awareness forum, also conducte at Tuticorin, included fishermen, stu dents, officials and NGO representative as participants. The forum made five ke recommendations to tackle issues relate to habitat and biodiversity loss of GOM Brochures in local language on conser vation of coral reefs and marine endan gered animals were published and dis tributed. A list of coral species was give for inclusion in the Indian Wildlife Pro tection Act.

Faunal Inventory under National Agriculture Technology Project (NATP)

Under the sub NATP "Germplasm Inventory, Evaluation and Gene Bank ing of Freshwater Fishes", detailed germplasm and habitat inventory were undertaken in prioritised North Eas

NE) and Western Ghats (WG) regions in collaboration with 12 centres. The emphasis was on prioritised endangered, potential cultivable and ornamental fishes. North-eastern region was divided into five regions while WG region was divided into three regions. A total of 111 species were recorded from five waterbodies viz., Beki, Manas, Dudhnoi, Krishnai and Pobitora, of southeast region of Assam. Except the Beki river, this is the first fish faunal inventory from these water bodies. Altogether 19 species were recorded from 28 rivers of north-east Assam and adjacent areas of Arunachal Pradesh and Meghalaya. Life history studies were initiated for *Labeo gonius* and *Neolissochielus hexagonolepis*. A total of 85 fish species belonging to 22 families were recorded from eight tributaries of the Brahmaputra river in north-west Assam and adjascent parts of Arunachal Pradesh. *Scizothoraicthys* sp. and *Johnius dussumieri* were recorded for the first time from upper Assam.

From six rivers of south-east Assam and adjacent parts of Tripura and Mizoram namely - Barak, Soni, Jatigaand, Katakhal, Tuirial and Gomti, 29, 28, 29, 21, 14 and 31 species respectively were recorded. Germplasm inventory in six waterbodies viz., Barak, Lokchao, Irang (all from Manipur) and Chatrik, Khuga and Leimatak (from Nagaland) yielded collection of 127 species belonging to 60 genera, 21 families and 7 orders. Six new species namely, *Akysis manipurensis, Puntius bizonatus, P. ornatus, Rasbora ornatus, Schistura macrocephalus and Silurus barkensis* were recorded from this region. Life history studies for six species : *Bangana dero, Chagunius nicholsi, Botia berdmorei, Danio naganensis, Neolissocheilus stracheyi* and *N. hexagonolepis* were initiated. A total of 179 species were recorded from eight rivers viz., Pamba, Achenkovil, Manimala, Periyar, Chalkkudy, Kabini, Valapatnam & Kuppam and Bharatapuzha of the middle stretch of Western Ghats in Kerala. The occurrence of *Pangio goaensis* was recorded for the first time from Manimala river. *Puntius singhala* recorded from Bharatapuzha river will be a new addition to the fish fauna of the country. Fifty seven species representing 29 genera, 12 families and 5 orders were recorded from 37 sites in northern and southern region of Western Ghats in Kerala and Tamil Nadu. Thirty-two species representing 18 genera, six families and four orders were collected in Tamil Nadu where as 47 species representing 25 genera, 12 families and 5 orders were collected from Kerala part of Western Ghats. Induced breeding was successfully achieved in three endangered and food fishes namely *Horabagrus bachysoma, Labeo dussumieri* and *Ompok malabaricus*. Two prioritised ornamental species of Western Ghats, namely *Danio malabaricus* and *Puntius melanmpyx* were successfully bred in captivity. Breeding technique for *H. brachysoma* and *O. malabaricus* were standardised for the first time in the country.

Technology Development and Transfer

The technique for captive breeding of endangered and endemic yellow catfish *Horabagrus brachysoma* was perfected in collaboration with Regional Agricultural Research Station, Kerala Agricultural University, Kumarakom. Milt cryopreservation of *H. brachysoma* was also achieved and young ones were produced with cryopreserved milt. The efficacy of cryopreservation technique in providing alternate sources of sperms of *Labeo rohita* when they are scarce in nature, was assessed in actual field conditions and transferred to progressive farmers in Punjab. The technique was also customised so that a large volume of eggs can be fertilised and cryopreserved space can be saved. The Bureau participated in four exhibitions at Chandigarh, Chennai, New Delhi and Mumbai and displayed various achievements of NBFGR. Extension bulletins/brochures and stickers with conservation messages in local languages were also distributed during these exhibitions.

New Initiatives and Future Projections for Xth Plan

The NBFGR envisages entry into several new areas of research and information in accordance with the mandate of the Institute. Some of the proposed programmes are given below.

Preparation of the biodiversity register : Preparation of interactive biodiversity related database for different major aquatic ecosystems of the country on GIS platform. This synergic approach will provide several pieces of information such as geographical position of the water body, environmental features, fishery data, etc. simultaneously on the digitised map without any time lapse.

Preparation of a CD-Rom facility: The nation's fish biodiversity information, and launching of a website of the Institute for the benefit of users like researchers, State Governments, etc. Database on shellfish and corals created during 10th Plan would form a part of this information facility.

Development of an aquatic biodiversity repository : This repository will be developed to catalogue fish specimens, and to genetically characterize fish tissues. In addition to the development of gene banking facility.

Conservation programmes

Species-specific recovery programmes : Work on selected endangered species would be initiated through a comprehensive approach. This would involve observations on biology of the species, habitat preference for different life-history stages, habitat restoration through community participation, breeding, ranching, gene banking, and development of hatcheries and nurseries exclusively for selected threatened species.

Creation of aquatic sanctuary: Identification of water bodies that are to be conserved as fish sanctuaries will be initiated during the 10th Plan. This will include river stretches, reservoirs, wetlands and water bodies within the protected area network .

Programmes for the North-East region: Survey of the fish genetic wealth of the north-eastern states will be on the priority agenda of the Institute. Identification of ornamental fish species, and their breeding and rearing will receive special attention. The institute proposes to identify important commercial and endangered species of the region and their habitats, and would have plans for developing hatchery techniques for their captive breeding, ranching and rehabilitation programmes. Water areas that are to be maintained as sanctuaries will be identified and efforts will be made to restore the habitat through public participation.

Training to youth and women: Ornamental fish rearing and hatchery practices will receive adequate attention. Mass awareness programmes and conservation activities through public participation will be implemented to develop the natural and commercial fishery of the north-eastern region. Endangered species like *Osteobrama belengeri* of the region will receive priority in conservation.

Involvement of women in conservation programmes: Women will be an important component in the conservation programmes to be taken up with public participation. Special training will be imparted to the women in aquarium maintenance, breeding and rearing of ornamental fishes, etc.

Application of fish genetics

Genetic characterization/DNA fingerprinting : These will be taken up for prioritised groups of commercial and endangered fishes from marine, brackishwater and freshwater ecosystems. Cytogenetic markers would also be probed into for delineation of stock/species. Development of genomic library for selected commercially important species would be a part of this work programme.

Quantifying genetic introgression in commercial species : Genetic introgression studies in major commercial species will be an important programme of the Institute during the Xth Plan. This would enable the use of better strains of the species for culture, ranching programmes and stocking in reservoirs leading to enhancement in yield.

Gene banking and application of sperm cryopreservation protocols in commercial farming: Application of long-term gene banking, development of sperm cryopresevation protocols with integration of information from genetic characterisation are the important aspects of this programme.

Retrieval of diploid genome through androgenesis and cloning: This work is proposed to be taken up in respect of both commercial and endangered species.

Monitoring of exotics

Establishing a facility for monitoring the introduction and spread of the exotics : This work will be a major task of the Institute extending all over the country in stages during the tenth Plan. This will include both official and clandestine introductions.

In the absence of definite criteria for the compatibility studies between exotic and native fish species, the Institute proposes to create facilities to conduct such studies under field conditions (in ponds) as well as under simulated conditions (in laboratory under modified flume tank conditions).

Quarantine facilities

Development of a P-4 level fish disease laboratory: The Institute, as a nodal agency for collecting and disseminating the information on fish diseases, would establish a P-4 containment laboratory for handling pathogens, and function as a referral laboratory for diagnosis of the diseases and pathogens of the native and exotic species. A disease risk analysis for the proposed exotics will be one of the thrust areas of the Institute.

Developing a network for monitoring and reporting fish diseases and pathogens in collaboration with other organizations: This would also be developed to serve as the national surveillance system in respect of the entry and spread of new aquatic diseases into the country. The Institute is already the nodal agency for reporting fish diseases through AAPQIS to the NACA. FAO. A digitised map will be prepared indicating disease prevalence, disease-prone zones and disease-free zones

Establishing a quarantine facility: This facility will be set up in respect of quarantining of the exotic fishes introduced in the country and a certification facility for the fish export consignments. In collaboration with other ICAR sister institutions, Ministry of Agriculture (Govt. of India) and the SAUs, a quarantine protocol and a quarantine network facility for the exotics will be developed during the 10th Plan.

Conclusion

In the light of the above achievements and the proposed new initiatives, it is felt that NBFGR can play a leading role in *ex situ* and *in situ* conservation of rich fish genetic diversity of India and their sustainable commercial utilisation.

Hindustan Lever to Shift its Surimi Plant from Visakhapatnam

It is learnt that the Surimi Plant now being operated by M/s. Hindustan Lever in collobration with M/s. Bigstar company is being shifted to Brahmavar in Karnataka. \The reason for this is stated to be the high cost of raw material which is making the operation unviable. The shifted has been decided upon after making study which has revealed that the cost per kg will come down by Rs.4/- if the operations are located at Brahmavar, which is a highly convienent point for the pooling up of raw material at a lower prices.

Although the Surimi Plant would be shifted from Visakhapatnam, the facilities available for processing of shrimp etc. at the plant would remain at Visakhapatnam.

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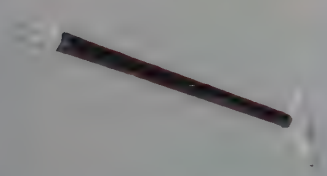
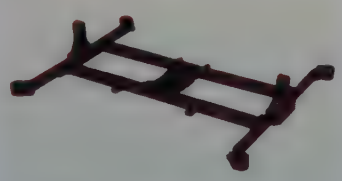


Plastic Shaft



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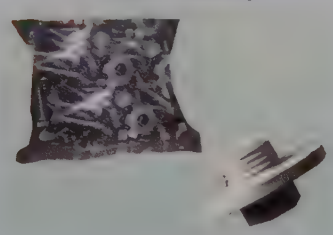
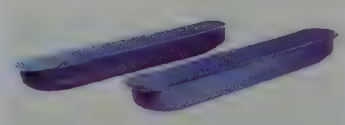


Screw Package &
Plastic Nut



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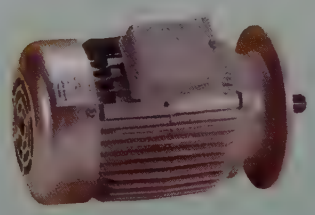
PE Cover

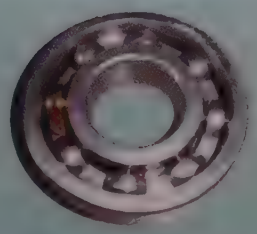
Plastic Impeller



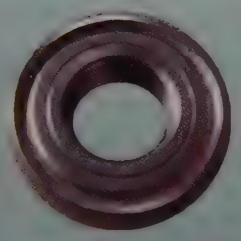
Motor

Reducer(14:1)

Motor fan



Reducer Bearing #6306



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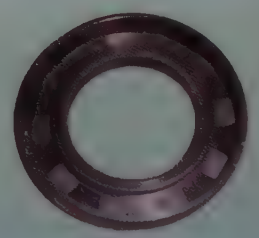
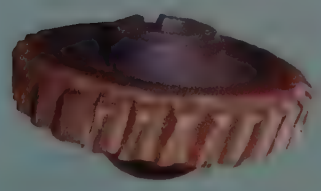


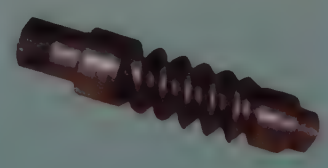
Oil Seal

Output Shaft



Worm Gear Wheel (14:1)

Reducer Bearing #30305



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Contribution of Central Marine Fisheries Research Institute to the Fisheries Sector

Mohan Joseph Modayil
Director
Central Marine Fisheries Research Institute, Cochin

Mohan Joseph Modayil

The Central Marine Fisheries Research Institute (CMFRI), over the years, has contributed significantly to the research and development needs of the marine capture fisheries sector which have been passing through fast changing scenarios from the past predominantly artisanal fisheries to the present industrial fisheries operating huge fleets of mechanised and motorised vessels in addition to the artisanal fisheries. The Institute's R&D activities on capture fisheries take into serious consideration the complexities characterising India's multigear, multispecies open access fisheries and the social and economic issues associated with them. Recognising the importance of mariculture in augmenting production by farming a potential area of 1.7 million hectares of coastal fallow land and vast areas of lagoons, bays, creeks and coastal waters, the Institute initiated a number of research programmes for the culture of various marine finfishes, shellfishes and algae and developed quite a few technologies which are being effectively transferred to the industry. The contributions of CMFRI are outlined below in brief.

Capture Fisheries

As a first step towards understanding of India's marine fisheries potential, the Institute carried out comprehensive taxonomic investigations and over 1,200 species comprising finfishes, crustaceans, molluscs, turtles, marine mammals, sponges, corals, echinoderms and seaweeds from the marine and estuarine regions have been identified to be of economic or potentially economic value. Several of these species were new to science or new records to the Indian waters. The distribution pattern and abundance of species over space and time on the continental shelf were studied and productive grounds mapped for all the major species and a strong scientific data base created for their biological and population characteristics, needed for fishery management purpose.

The Institute has developed a proper statistical design called "Stratified Multistage Random Sampling Scheme" for the estimation of marine fish landings in the country and for the stock assessment of India's multi-species and multigear fisheries. Regular estimates of marine fish production are being made districtwise, gearwise and specieswise since 1950 and time-series information is disseminated to user agencies.

Census of fisher population, gears, crafts, employment details, educational standards and infrastructure facilities available at fish landing centres is taken periodically through structured surveys.

Intensive studies were made on primary and secondary productivity, coastal upwelling and mixing of water masses and circulation in the neritic waters and the results correlated with the major fisheries. Other important fishery-related aspects studied include qualitative and quantitative abundance of fish eggs and larvae, distribution of Antarctic Krill, ecology of mangrove areas, seagrass meadows, corals and corals ecosystems, marine pollution, mud bank formation and bioactive agents from marine animals and plants.

Based on the data so far collected by the Institute on fish landings and primary and secondary productivity, the potential yield in the 0-50 m depth zone of the EEZ has been revalidated region-wise and species-wise by the Working Group appointed by the Ministry of Agriculture, Government of India in 1990. Also for the first time in the country, national level stock assessment has been made for as many as 45 major exploited finfish and crustacean species, and the results indicating the effort limits for maximum sustainable yields of individual species have been published.

Extensive resource surveys in the outer EEZ of India were conducted by exploratory/experimental fishing programmes and several new resources of deepsea fishes, shrimps, lobsters, crabs and cephalopods on the upper continental slope (200-900m) have been located. The productive grounds of these resources have been charted out and potential stocks estimated to facilitate commercial exploitation. Investigations on the deepsea lobster migrations and the biocomposition in our EEZ were carried out.

The issue of bottom trawling during monsoon period and the connected socio-economic problems prevailing along the west coast were examined and critically appropriate recommendations for proper exploitation, management and conservation of the resources were made.

The socio-economic aspects of fisher families in Kerala, Maharashtra and Gujarat have been investigated and the economics of fishing operations of different types of fishing units of traditional, motorised and mechanised sectors, and marketing aspects such as price spread at various levels, besides the role of women in small scale fisheries activities have been studied.

The base line data generated through studies, from the EEZ, and from the coastal zone for over the last 5 decades on the environment, hydrography, biodiversity, fisheries etc. have been utilised for formulating the National Fisheries Policy, Revalidation of Marine Fisheries Potential Yield in the Indian EEZ, for forming CRZ, for forming Biodiversity Act, and for candidate species identification for CITES etc. of the country.

Mariculture

Considering the increase in demand for fish and the limitation in increasing production from capture fisheries, the Institute focused its attention on mariculture research during the last 20 years and developed viable technologies for seed production and culture of marine crustaceans, molluscs, seaweeds, sea cucumbers and marine ornamental fishes. Among crustaceans, 18 commercially important species of shrimps and three species of crabs have been bred in captivity and studies on their larval phases under controlled conditions have been completed. Shrimp hatchery technology has been developed and perfected for *Penaeus indicus*, *P. monodon* and *P. semisulcatus*. The technology of induced maturation for broodstock has been considerably simplified for *P. indicus*, *P. semisulcatus*, *P. latisulcatus* and *M. dobsoni*. The prospects of farming *P. indicus* in saltpan reservoirs and *P. semisulcatus* in marine conditions have been established.

Marine penaeid shrimps (*Penaeus semisulcatus* and *P. indicus*) were successfully enabled to attain maturity and spawn repeatedly in captivity by environmental regulation and feed management without resorting to eyestalk ablation. Viable eggs were produced in each spawning of 5-7 day intervals. Artificial insemination technique in *P. monodon* leading to spawning was perfected. This technique will be helpful in the repetitive use of expensive spawners for a prolonged period without loss in the viability of the spawn. Breeding technology for the marine pelagic crab *Portunus pelagicus* was developed and perfected. Success was achieved in larval rearing of the spiny lobster *Panulirus homarus* and the mud crab *Scylla tranquebarica*.

The Institute achieved break-through in developing technology for the culture of pearls and farming of the pearl oyster *Pinctada fucata* in open sea as well as shore based systems, which has laid the foundation to embark upon commercial scale pearl production in the country through aquaculture which so far remained the monopoly of developed countries like Japan. Technologies have also been developed for commercial culture of edible oyster *Crassostrea madrasensis*, marine mussels *Perna indica* and *P. viridis*, the blood clam, *Anadara* etc. and their techno-economic viability has been tested through pilot projects and demonstration programmes. In order to meet the seed requirement for bivalve culture, hatchery technology has also been developed and perfected for all the candidate species of oysters, mussels and clams. Experiments have also proved successful for seed production of the gastropod *Xancus pyrum* and cephalopods in hatcheries. Sea ranching experiments on exploited molluscs like pearl oyster, *Xancus pyrum*, *Trochus* sp., *Turbo* sp. and giant clam were successfully undertaken in many parts of the country. Another breakthrough was achieved in the cuttlefish hatchery development and development of F_1 generation of the cuttlefish under controlled conditions at Tuticorin.

The Institute succeeded in broodstock development, maturation, sex reversal, spawning, fertilisation and hatching of the grouper onshore under fully controlled culture system at Cochin, thereby opening up avenues for developing suitable package for culture of groupers. Technology of breeding and seed production of clown fish (*Amphiprion chrysogaster*) has also been perfected and batches of juveniles are now available for sale at the Marine Aquarium at Vizhinjam.

Sea cucumber farming technology developed : The possibility of augmenting production of the commercially important sea cucumber *Holothuria scabra* through seafarming has been established and technology developed for its breeding and seed production for the first time in the world. The country thus acquired global monopoly in sea cucumber seed production technology.

The Institute carried out extensive work on culture of the agar-yielding seaweed *Gracilaria edulis* and recorded 4-5 fold increase in production in three months by vegetative fragment culture (net/rope culture) method. Commercial viability of seaweed culture has been demonstrated in the Gulf of Mannar and Minicoy lagoon.

The essentiality and dietary requirements for essential fatty acids and certain vitamins have been worked out for the shrimp *Penaeus indicus*, along with protein, lipid and carbohydrate requirements. Nutritional studies on the mullet, *Lisa parsia* have also been carried out.

Live feed culture : The development of the mass production technology of live feeds, both micro-algae and zooplankters such as rotifers, cladocerans and brine shrimp, offers immense scope to meet the feed needs in mariculture and their production can run concurrently with the mariculture programmes. The success of any hatchery system, either of shellfish, finfish or even sea cucumber, entirely depends on the availability of suitable live feed organisms, especially in the critical stages of development of the rearing organisms in a hatchery system. The Institute has developed technologies for the maintenance of almost all the micro algae and zooplankters for the mass production of these to serve as live feed, depending on the organisms being reared in hatcheries, be they crustaceans, molluscs or fishes.

Commercial Production of Pearls : Utilising Rs. 30 lakhs sanctioned under ICAR Revolving Fund Project, the Mandapam Regional Centre developed a full-fledged pearl oyster hatchery with a production capacity of 2.8 million spat

per year. A pearl oyster farm of 750 sq.m. was also set up in the Gulf of Mannar. The project has so far earned Rs. 10.52 lakhs through the sale of pearls, pearl oyster seeds and mother oysters. Further, 12,007 nos. of pearls valued at Rs.8.42 lakhs are currently available for sale.

Sea ranching: Sea ranching experiments carried out using the hatchery reared and farm grown *P. semisulcatus* in Mandapam have revealed that ranched juvenile shrimps gained recruitment into the commercial fishery whereby proving that sea ranching could be used as an effective tool to improve threatened and depleted stocks.

Revival of pearl oyster (*Pinctada fucata*) beds from extinction and repopulation of existing beds in the Gulf of Mannar and Palk Bay through ranching of the seed produced in the hatchery are two of the most significant objectives of the CMFRI. The first programme on ranching was launched in 1985. This was continued and more than one million spat were ranched during a period of 5 years. Subsequent dives made in the beds clearly indicated replenishment of the pearl beds as seen from the number of oysters collected in one diving hour. Stock enhancement (sea ranching) through captive reared pearl oysters is a technique, which aims at rebuilding the wild population from its destruction by man-made and natural causes.

Transfer of Technologies

The Institute through various extension programmes has been transferring the proven technologies developed on various aspects of mariculture for the benefit of coastal communities for commercial adoption through training, demonstration and exhibition programmes. Organisation of Summer Institutes and Group meetings has been a regular feature to create public awareness on shrimp culture, pearl culture, edible oyster culture, mussel culture and seaweed culture. Training is also imparted on fishery resources assessment, underwater diving and use of acoustics in fishery exploratory surveys. Those trained include candidates sponsored by maritime State Fisheries Departments, Agricultural Universities, Developmental agencies like MPEDA, and also foreign nationals.

Lab-to-land programmes organised by the Institute in Karnataka, Kerala and Tamil Nadu imparted practical training to fishermen and small farmers, in their own fields, on scientific methods of culturing shrimps, fishes, mussels and seaweeds at the respective places where culture technologies were developed. Operational research projects and demonstration programmes were taken up for blending seafarming with capture fisheries and several enterprising fisher families were trained in undertaking mariculture of finfishes, shrimp, mud crabs, mussels, edible oysters, etc., in such a way that these could be practised along with their routine capture fishing activities for improving their earnings.

Pearl culture with full involvement of local fishermen had been demonstrated at Valinokkam, a coastal village near Tuticorin in Tamil Nadu. A "Pearl Festival" was organised on 4 May 1992 to mark the success of this Transfer of Technology Project on cultured pearl production.

A simple, low cost shrimp feed technology (MAHIMA) was developed by the Institute with a production of about 1 to 2 tonnes per day. The institute helped the All-Women Small-scale Industries in central Kerala to adopt the technology.

The research results were imparted to the beneficiary societies, sectors, policy planners at State/Central Government level at the appropriate times in order to facilitate marine living resources management and for sustainable production, to alleviate intersectoral conflicts, facilitate crisis management, ensure better utilisation of potential resources and to safeguard threatened fish and finfish habitats.

The Fishermen-Farmers-Industry Meets are being conducted every month at the Institute's Headquarters and at all its Research Centres since May 1995 in order to motivate adoption of CMFRI technologies and the technologies developed, particularly MAHIMA feed technology, were disseminated among the farmers, Industry and other end users. So far 40 such monthly Meets on various themes were conducted.

Manpower Development

Besides the major responsibility of conducting applied research on marine fisheries and its cognate aspects the Institute played an important role in human resource development through various higher education programmes in capture and culture fisheries disciplines. The Institute has been recognised by many Universities as a Centre of Post graduate research leading to M.Sc. and Ph.D. degrees. Over 50 scientists of the Institute holding doctorate degrees have been recognised as research guides for supervising Ph.D. work. The scientists have also served as members on several Advisory Committees, Board of Examiners of Universities, etc.

Post-graduate Programme in Mariculture (PGPM) : During the past 23 years the Institute has been conducting a Post-graduate Programme in Mariculture with the objective of generating adequate manpower in the field at managerial/ supervisory levels. So far, 20 batches of M.Sc./M.F.Sc. and 19 batches of Ph.D., each with an intake capacity of 10, have completed the programme. Over 90% of these candidates, after successful completion, got employed in R&D organisations, Banks and fishing/aquaculture industries.

Training Programmes : Recognising the crucial role of training in marine fisheries development and transfer of technologies, the CMFRI has been offering training within the purview of the Institute's mandate.

CMFRI is identified as a nodal Institution in the country under the Regional Seafarming Development and Demonstration Project of the FAO/UNDP. Under this project, a month-long international training programme on pearl culture was conducted successfully in 1991, earning appreciation and acclaim from all the 26 participants drawn from 10 South Asian countries.

Two training programmes for college teachers of vocational course in the discipline 'Industrial Fish and Fisheries' sponsored by UGC were conducted at Headquarters during 1995 and 1996. The participants were given training in the taxonomy, distribution and biology of finfish and shellfish resources and mariculture.

Krishi Vigyan Kendra (KVK) : The Krishi Vigyan Kendra (KVK) of the Institute established in 1976 has been engaged in giving training to small and marginal farmers on mariculture and the Kendra made considerable progress in popularising mariculture and other forms of coastal aquaculture among the rural communities for upgrading their living standards. The activities of KVK include 'teaching by doing' and learning by doing' in fisheries and allied areas, on-farm testing of technologies, inservice training of extension personnel and organising frontline demonstration. Since 1977, 1,087 training courses have been conducted benefiting 21,327 participants.

Trainers Training Centre (TTC) : The Trainers' Training Centre (TTC) established in 1983 at Cochin has been imparting skill-oriented training to inservice personnel nominated by State and Central Government Organisations, Universities, Banks and prospective farmers in the latest technologies in farming of fishes, shrimps, oysters, pearl oyster and in pearl and seaweed production, SCUBA diving and in marine fisheries resource assessment. The training is imparted through work experience, lectures, field visits, demonstration and discussions. From 1983 onwards, 137 training courses were organised benefiting 1,432 participants.

Summer Institutes : The Institute organised Summer Institutes relating to the identified subject areas such as mariculture and other forms of coastal aquaculture, breeding and rearing of shrimps, culture of edible molluscs, hatchery production of shrimp seed and culture of shrimps, finfish and shellfish nutrition, eggs and larvae, culture of molluscs, marine fishery resources assessment and management and marine fish stock assessment methods and models. The Summer Institutes also provided an opportunity to participants to learn the new technologies developed in capture fisheries and in the emerging field of mariculture, and to discuss the problems associated with them. The thrust given for field work helped the participants to gain practical knowledge in various aspects of mariculture.

Workshops/Seminar/Symposia : The Institute organised a number of Symposia, Seminars, Conferences, and Workshops on various subjects of topical interest and of R&D importance in marine capture fisheries particularly scombroids including tuna, on culture of bivalves, *Beche-de-mer*, and on scientific results of FORV Sagar sampada.

Consultancy Services : The Institute has been extending consultancy services on matters relating to aquatic environmental problems, EIA studies, marine and estuarine fisheries management, fisheries education, and on coastal aquaculture including establishment of hatcheries and grow-out systems for shellfish and sea cucumbers in and outside the country. The Consultancy Processing Cell at the Headquarters finalises and coordinates the operation of the consultancy projects at various centres. The Institute has so far generated Rs. 1.26 crores of income from 38 projects.

Linkages

The CMFRI has developed linkages and maintains them with several national and international research and development organisations and Universities for collaborative research works in marine fisheries. The linkages established in the major areas of fisheries research with the organisations are given in the chart presented on the next page.

Institute's Publications

Several periodical publications as detailed below are issued from the Institute:

1. Indian Journal of Fisheries is a primary journal documenting original research results on marine fisheries and allied subjects achieved within the country and abroad. Being publishing since 1954, the journal was released as half-yearly volumes till Vol. 30, 1983, but from Vol. 31, 1984 onwards the issues have been increased to 4 quarterlies. Vol. 47, Nos. 1 to 4 has been issued recently.

2. CMFRI Bulletins are being issued from time to time since 1968, to disseminate current knowledge in the various fields of research on marine fisheries and allied subjects in India. The Bulletin is monographic in nature. Upto Bulletin No. 24, 1970, the bulletins were mimeographed, but from No. 25 onwards they are being released in printed form. So far 48 Bulletins have been published.

3. CMFRI Newsletter provides details of important activities of the Institute; No. 89 is the current issue.

4. CMFRI Special issues are occasional publications, started in the year 1977. They incorporate the results of short-term research projects of the Institute. So far 70 numbers have been issued.

5. Marine Fisheries Information Service: Technical & Extension Series are being released as a monthly publication since September 1978. The objective of this publication is to ensure the rapid dissemination of information of marine fisheries resources and allied data available with the Fishery Data Centre and the Research Divisions of the Institute, results of researches for transfer of technology to the fish farmers and industry, and of other relevant information needed for research Development efforts in the marine fisheries sector; No. 164 is the current issue.

6. Annual Reports of the Institute are issued for each financial year. The progress of research projects implemented during a year, and the salient research findings and the overall activities and Research Highlights of the Institute are reported in the Annual Reports.

Besides the above serial publications, which form valuable immediate refer-


DEPT. OF BIOTECHNOLOGY
(Sponsored Projects)
INDIAN SPACE RESEARCH ORGANISATION
(National Natural Resources Management System)
NATIONAL REMOTE SENSING AGENCY
(Remote Sensing and Fisheries)
MINISTRY OF AGRICULTURE, GOVT. OF INDIA
(Collaborative Work)
DEPARTMENT OF OCEAN DEVELOPMENT
(Assessment of Marine Living Resources through FOR V Sagar Sampada)
MARINE PRODUCTS EXPORT DEVELOPMENT AUTHORITY
(Sponsored Projects)
CENTRAL SALT AND MARINE CHEMICALS RESEARCH INSTITUTE, (Seaweed Resources)
NATIONAL INSTITUTE OF OCEANOGRAPHY
(Collaborative Work)
CIFE (DEEMED UNIVERSITY)
(M.F.Sc. and Ph.D. Programmes)
OTHER RESEARCH INSTITUTE OF ICAR
(Collaborative Programmes)
STATE AGRICULTURAL UNIVERSITIES/UNIVERSITIES
(Faculty Improvement Programme)
ICLARM PROJECT
(ADB - RETA S766)
CENTRAL INSTITUTE OF FISHERIES TECHNOLOGY
(Collaborative Work)
CENTRAL INSTITUTE OF FRESHWATER AQUACULTURE
(Collaborative Work)
CMFRI
(Sponsored Projects)
FAO/UNDP PROJECTS/USIF
REGIONAL SEFARMING DEVELOPMENT AND DEMONSTRATION PROJECT (Country Participation/Nodal Institute)
MINISTRY OF ENVIRONMENT AND FORESTS, GOVT. OF INDIA (Collaborative Work)
NATIONAL BANK FOR AGRICULTURE AND RURAL DEVELOPMENT (Sponsored Projects)
CENTRAL INSTITUTE OF FISHERIES, NAUTICAL AND ENGINEERING TRAINING (Collaborative Work on Marine Resources)
INDIAN AGRICULTURAL STATISTICS RESEARCH INSTITUTE (Training)
FISHERY SURVEY OF INDIA
(Marine Fisheries Resources Survey of the Exclusive Economic zone)
INTEGRATED FISHERIES PROJECT
(Postharvest Technology)
DEPARTMENTS OF FORESTS, ORISSA AND TAMILNADU
(Turtle Conservation)
FISHERIES DEPARTMENTS OF MARITIME STATES
(Transfer of Technology)
FISHING INDUSTRY
(Consultancy)
CENTRAL INSTITUTE OF BRACKISHWATER AQUACULTURE (Collaborative Work)
CENTRAL AGRICULTURAL RESEARCH INSTITUTE, PORTBLAIR (Collaborative Work)

ence materials, the Institute has also published symposium proceedings and two books, one on Marine Biodiversity Conservation and Management and another on Marine Fisheries Research and Management.

Future Priorities of Institute's Programmes

The research and development programmes of the Institute to be implemented in the coming years will focus on : Sustained fish production from the presently exploited inshore waters, conservation and management of stocks, increasing fish production from unexploited and underexploited offshore and deepsea grounds, developing and operating forecasting models for fish stocks in relation to environmental factors, environmental and socio-economic impact studies, and on augmenting production through culture and effective transfer of the technologies. There will be greater emphasis on post-graduate education in mariculture and on research efforts in frontier areas such as marine biotechnology, fish and shellfish pathology, genetic engineering of fish and shellfish nutrition and endocrinology. The following are the short-term and long-term research projects envisaged to increase the productivity and per capita availability of fish and fish products to the people:

a) Monitoring and periodically assessing the stocks of exploited inshore resources for proper management, conservation and sustained production.

b) Mapping of fishing grounds and assessment of non-conventional and emerging fishery resources such as mesopelagic fishes, oceanic squids, deepsea shrimps, lobsters and crabs in the outer EEZ, besides investigations on the role of deepsea lobsters, in oceanic food web and production;

c) Development of computer based fishery forecast models and dissemination of information thereof; Forecasting fish yields using appropriate predication models;

d) Identification of conservation needs for protection of marine biodiversity. Establishment of a Biodiversity Division at the Headquarters;

e) Development of technologies for seed production and farming of fishes such as seabass, groupers and ornamental fishes;

f) Development and standardisation of hatchery and farming technologies for potential marine shrimp species, lobsters, brachyuran crabs, king crabs and molluscs leading to commercialisation;

g) Development and standardization of technologies for sea ranching of commercially important crustaceans, molluscs and sea cucumbers to enhance the wild stock;

h) Identification of invertebrates and plants of pharmaceutical/toxicological importance and documenting their mariculture potentials;

i) Consolidation and transfer of marisel to the industry and for providing training in diversified fishing methods.

The non-governmental organizations sought training programmes on preparation of value-added products and hygienic drying of fish for the benefit of traditional fishermen.

The need for introducing alternative cultivable species to diversify from tiger shrimp culture was put forth aquaculturists.

Representatives of marine products processing sector, boat-owners, Central and State fisheries research and training institutes, NGOs, Marine Product Export Development Authority and aquaculturists participated in the discussions related to sustainable and responsible fishing, value addition, quality control, research priorities, product development, training, technology transfer etc.

The Deputy Director-General (Fisheries) of ICAR Dr. K. Gopa Kumar, said the draft comprehensive national fishery policy for the growth of the fishery sector had already been submitted to the Union Government.

culture technologies of pearl oyster, edible oyster, clam, mussel, chank, sea cucumber, seaweed, shrimp and finfishes and their integration with artisanal capture fishing effort;

j) Socio-economic evaluation and impact assessment studies of capture and culture fisheries; and

k) Application of biotechnology for genetic improvement in cultivable animals and plants and in oyster mantle tissue culture and *in vitro* production of pearls, marine pollution, diagnosis of fish and shellfish disease, maturation of animals and production of bioactive substances from sea.

Through the various tasks implemented over the years the Institute has played a significant role in the phenomenal growth of the marine fisheries sector of India in terms of fish production and the socio-economic development of the coastal rural communities of the country. The discovery of various new resources in the distant waters through exploratory surveys and the mariculture technologies developed for a number of economically prime marine species like shrimps, bivalve molluscs, seaweeds and sea cucumbers has substantially increased the productivity of the sector and played a major role in generating employment potentials besides upgrading the socio-economic condition of the coastal rural communities. It is expected that the research priorities listed above, once implemented, will go a long way in attaining the anticipated fish demand of about 1[2] million tonnes by 2020 AD.

Need for Comprehensive Fishing Policy Emphasised

The need for evolving a comprehensive fishing policy for the country was highlighted at an Institute-Industry meet organised by the Central Institute of Fisheries Technology at Visakhapatnam on 14 April 2002.

The meet also called for diversification of fishing vessels for catching tuna, transfer of the design of 15.5m LOA fuel-efficient CIFT designed fishing ves-

Fisheries Education in India

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Human resource development (HRD) is a critical input r sustainable utilisation of fisheries resources. cognising the importance of HRD, two training centres, e at Barrackpore for Inland Fisheries and the other at andapam for marine fisheries were started in 1945. The ajor step in HRD in fisheries however was the establishent of Central Institute of Fisheries Education (CIFE) Mumbai in June 1961, to provide professionally trained anpower, for the upcoming fisheries industry. Fisher- s education under the State Agricultural University AU) system started only in 1969 with the establishment the first fisheries college at Mangalore under the aus- ces of the University of Agricultural Sciences, Banga- re. Presently, 11 SAUs, one Central Agricultural University and the CIFE, Mumbai (Deemed University) offer fisheries education in the country. Recognising the need for maintaining high standards in agricultural education including fisheries, Indian Council of Agricultural Research (ICAR), New Delhi, initiated several measures, such as uniform curricula, strengthening of infrastructural facilities and faculty, external evaluation, development of instructional material and accreditation. In the light of changing needs of fisheries sector and globalisation, Undergraduate (UG) and Postgraduate (PG) course needs, and aspects of Distance Education, Vocational Education and training and extension programnmes to provide professionally qualified and trained manpower to the fishing industry have been outlined.

Fisheries sector has been recognised s a powerful income and employment enerator as it stimulates growth of a umber of subsidiary industries and is a ource of cheap animal protein. It is an nstrument of livelihood for a large sec- ion of economically backward popula- ion of the country. About 7 million eople dirtectly or indirectly depend on he fisheries sector. During 2000-2001, he volume of sea food exported was 121,071 tonnes worth Rs.6309 crores. During 1998-99, fisheries sector contrib- uted Rs.22,223 crores to the total Gross Domestic Product (GDP), forming 1.4% of the total and 4.73% of the GDP from griculture.

India has an estimated overall fish production potential of 8.43 million tonnes, with 3.9 million tonnes expected from marine fisheries. As against the said potential, the country is producing 5.66 million tonnes (during 2000-2001) with a contribution of about 50% each from marine and inland fisheries. Based on the total fish production, India occupies third position in the world contributing little over 4% to the world fish production. In the case of inland fish production, our country ranks second in the world and occupies an important place in Asian aquaculture. The current per capita availability of fish per annum works out to about 10 kg for the fish eating population of the country, which is less than the minimum requirement of 11 kg recommended by the World Health Organisation.

The structure of fish production in the country has undergone significant changes over the years. In 1950-51, the share of marine fisheries was 71% of the total fish production of 7.52 lakh tonnes. During 1970s and 1980s, the share of inland fisheries was just above one third of the total fish production.Later it gradually increased to reach 40% in 1990-91 and 50% in 2000-2001. The increase in the share of inland fish production was on one hand due to deceleration in growth of marine fish production and on the other because of a policy shift in favour of inland fisheries, especially aquaculture. In fact, the faster growth in inland fish production was mainly due to aquaculture. The share of culture fisheries (aquaculture) in inland fisheries has shown tremendous increase during the last few years. It rose from 43% in 1984-85 to about 80% in 1999-2000.

The country has a long coastline of about 8,118 km, with an Exclusive Economic Zone (EEZ) of 2.02 million square kilometers, besides varied inland fisheries resources comprising rivers and canals (1,91,000 km), reservoirs (3.15 million ha), ponds and tanks (2.25 million ha), Lakes, *Beels* (oxbow lakes) and swamps (1.3 million ha) besides brackishwater area of 1.4 million ha.

The coastal fishery resources are over-exploited in many areas and require effective management for sustainable production. At the same time, there is considerable scope for expansion of fishing effort in offshore and oceanic regions of the EEZ. While all the potential of the inshore waters (upto 50 m depth) has been realised, the contribution from deep sea zone has been negligible. The fisheries potential of inland resources, however, has not been tapped adequately. Only about 30% of the freshwater area and 10% of the brackishwater area have been utilised for aquaculture. The productivity of freshwater aquaculture in 1998-99 was about 2 t/ha/yr, while there is a potential to raise yield up to an average of about 10 t/ha/yr. The productivity of brackishwater aquaculture in 1998-99 was about 0.5 t/ha/crop as against the potential of about 4 t/ha/crop.

In order to bridge this gap between production and potential, and to sustain fisheries in the new millennium, the quality, technical skills and managerial skills of fisheries manpower in the country will have to improve in consonance with the rapidly changing needs of our society. In this context, Human Resources Development (HRD) for raising a cadre of experts at various levels to support research and promote a sustainable development of the fisheries sector is critically important. This paper traces fisheries education in the country, and suggests HRD to cater to the emerging needs of fisheries sector.

Historical Perspective

Organised thrust for development of fisheries of India started with the 'Grow More Food' campaign during 1940s and the first training centre for inland fisheries was started in 1945 at Barrackpore, now in West Bengal. A few months later the training centre for marine fisheries was started at Mandapam camp, now in Tamil Nadu. The Marine Fisheries course at Mandapam, which was attached to Central Marine Fisheries Research Institute was later closed, as it could not attract candidates for training for various reasons. The inland fisheries course was later attached to Central inland Fisheries Research Institute (CIFRI) ,Barrackpore in 1947 and to Central Institute of Fisheries Education (CIFE), Mumbai in 1967. This certificate course has been highly popoular in meeting the requirements of development and extension officers at block and district levels. The inland fisheries course continues till today under the CIFE, Mumbai, now as a Diploma course in Inland Fisheries.

Fish and Fisheries Science did not figure as a subject in any of the Indian Universities even in 1950s, although some universities in the country were offering 'fish' or 'fisheries' as a special paper in post-graduate programmes in Zoology and allied disciplines. The Central and State Governments had to recruit general graduates and post-graduates of zoology discipline for manning the management positions in fisheries sector. Consequently, these recruits had only limited knowledge of the multi-disciplinary subject of fisheries and acute shortage of qualified and trained manpower continued to be felt.

Following the expansion of fisheries developmental activities in the country with increasing outlay in the successive five year plans, the Government of India constituted and ad-hoc Committee on 'Fisheries Education' in 1959 for assessing the manpower requirements and suggesting measures for providing trained manpower at various levels for giving further boost to fisheries developmental activities. Finding that the existing colleges and universities in India did not provide any formal course in fisheries, the Committee suggested the establishment of a post-graduate training institute to impart training to district level fisheries officers, deputed by various State Governments. As a result, the CIFE was created by an order of the Ministry of Agriculture, Govt. of India on 6 June 1961 at Mumbai to offer two year post-graduate Diploma Course in Fisheries Science (D.F.Sc.) for inservice officers of state fisheries departments. To meet the trained manpower needs of oceangoing fishing vessels and fishing industry, the Committee recommended the establishment of Central Institute of Fisheries Nautical and Engineering Training (CIFNET) at Kochi in 1963. During the same year, Marine Products Processing Training Centre (MPPTC) was established at Mangalore under Indo-Japanese collaboration for training processing technologists. The introduction of mechanised fishing in the costal waters in the 1950s led to the establishment of Fishermen Training Centres in all the maritime states. In course of time, most of the State Governments established a series of inservice training centres for their technical personnel at different levels.

As mentioned earlier, the Inland Fisheries Training Centre, till then functioning under the CIFRI, Barrackpore, in West Bengal, was attached to CIFE in 1967. The CIFE also took control of the erstwhile Fisheries Extension Centres of the Government of India and reorganised them as Centres for Inland Fisheries Operatives Training Centre and Fisheries Extension Training Centre which were, however wound up in 1995, in view of starting of several bay Fisheries Colleges in the country. In 1971, the University of Bombay accorded recognition to CIFE as a study centre for M.Sc. and Ph.D programmes by research in the fields of Applied Zoology and Biochemistry. Several other universities such as Calcutta and Bhopal also recognised CIFE as a study centre for Ph.D. programmes. The charter of CIFE was later enlarged to cover research and extension activites besides academic programmes, with the Institute coming under the administrative control of the Indian Council of Agricultural Research (ICAR), New Delhi, in 1979.

Master's degree programme in fisheries Management was started by CIFE in 1984 under affiliation to the University of Bombay. Later in recognition of the pioneering role played by CIFE in Fisheries Education,the University Grants Commission conferred on it the Deemed to be University (DU) status in 1989.

The CIFE at its Headquarters (Mumbai) presently conducts Masters programmes in the disciplines of 'Fisheries Resources Management', 'Inland Aquaculture', 'Fish Genetics and Breeding', 'Fish Microbiology and Pathology' and 'Fish Biochemistry and Nutrition' and Doctoral Programmes in the first mentioned two disciplines. Master's programmes in Freshwater Aquaculture is offered at Central Institute of Freshwater Aquaculture (CIFA), Bhubaneswar under CIFE(Deemed University). The Master's and Doctoral programmes in Mariculture which were earlier conducted by the Central Marine Fisheries Research Institute (CMFRI) under Cochin University of Science and Technology were also brought under the jurisdiction of CIFE (Deemed University) in 1995. Master's and Doctoral programmes in 'Post Harvest Technol-

ogy' under CIFE (Deemed University) are offered at the Central Institute of Fisheries Technology, Kochi. The D.F.Sc. course, which was responsible for development of skilled and trained manpower till recently, was discontinued by CIFE with effect from the academic year, 1998-99, subsequent to initiation of Master's degree programmes in several disciplines.

Fisheries education under the State Agricultural/Veterinary University (SAU) system started only in 1969 with the establishment of the first fisheries college at Mangalore under the auspices of the University of Agricultural Sciences, Bangalore, Karnataka. Fisheries education *per se*, is thus less than four decades old in India as compared to that in animal sciences and agriculture, which have now almost a century old tradition. Today, 11 of the 30 State SAUs and one Central Agricultural University (CAU) offer Fisheries Education in the country (Table 1). All these colleges offer four year degree programmes in Bachelor of Fisheries Science (B.F.Sc.), while Master of Fisheries Science (M.F.Sc.) is offered by six of them and Ph.D. by four of them. Rajasthan Agricultural Univeristy offers M.Sc.(Ag.) in Fisheries Limnology at its College of Agriculture, Udaipur. Parmar University of Horticulture and Forestry, Solan, Himachal Pradesh offers Master's degree in Fish Processing Technology. Thus, Fisheries education got recognition as distinct from inservice training, only after fisheries courses were introduced in SAUs.

Indian Institute of Technology, Kharagpur (West Bengal) offers M.Tech and Ph.D. courses in Aquaculture Engineering. Several Colleges and Institutions under the general universities offer specialisation in one or the other aspect of Fisheries at M.Sc. and Ph.D. level in Zoology. Further, several Universities also conduct M.Sc. and Ph.D. programmes in Marine Sciencies, Marine Biology, Oceanography, Aquatic Biology and Fisheries, Limnology and Fishery Technology, Aquatic Environmental Sciences and Applied Aquaculture for regular and self financing streams of students.

The technology transfer and extension education was given further thrust by the ICAR by opening Krishi Vigyan Kendras (Farm Science Centres) and Trainer's Training Centres (TTC). In KVKs, fish farmers are trained in available technologies according to their needs. In the fisheries sector, three important KVKs are functioning, at Bhubaneswar (CIFA), Orissa for inland fish culture, Narakkal (CMFRI), Kerala for mariculture and Kakdweep (CICFRI), West Bengal for brackishwater aquaculture. There are only two TTCs, one each at CIFA Bhubaneswar and CMFRI, Kochi, where the trainers from the State Department of Fisheries, NGOs and others are trained for periods varying from 3 to 6 months.

Non-availability of trained and qualified teachers, lack of infrastructural facilities and equipments have been hindering the progress of vocational courses in fisheries. Consequently, State Governments have introduced vocational courses on fisheries at 10+2 level with the active assistance from National Council for Educational Research and Training (NCERT) in developihg curricula, books and instruction material. Seven vocational courses viz., Fisheries, Aquaculture, Fishing Craft and Gear, Fish Processing Technology, Inland Fisheries, Maintenance and Repair of Marine Engines and Marine Fisheries are conducted.

Training programmes of short duration are also conducted by ICAR Fisheries Research Institutes and Fisheries Colleges under SAUs for the benefit of scientists and teachers under Summer/ Winter Schools and Centre for Advanced Studies. Need based short term training programmes are also organised for the benefit of fishers, fish farmers, entrepreneurs and NGOs by the ICAR Fisheries Research Institutes and Fisheries Colleges as part of thier extension programmes.

Short-term Training Programmes are also conducted by private institutes like MAC School of Aquaculture of Tuticorn in Tamil Nadu and Raman Academy of Kakinada, in Andhra Pradesh. The MAC School of Aquaculture offers four courses Viz.: (1) Five months Undergraduate Diploma in Shrimp Farming for SSLC candidates, (ii) Five months graduate Diploma in Shrimp Farming for B.Sc. (Zoology) candidates, (iii) Two months Postgraduate Diploma course in Shrimp Farming for M.F.Sc., B.F.Sc. or M.Sc. (Biology) holders, and (iv) 15 days Shrimp Farming Training Certificate for entrepreneurs. The Raman Academy offers certificate courses in Prawn Farming Management and Fish Farm Management and Diploma course in Aquaculture and Postgraduate Diploma course in Aquaculture of differing durations.

Quality Improvement in Fisheries Education

Uniform curricula:Several measures taken by the Education Division of ICAR, have been successful in bringing uniformity in curriculum of UG courses in fisheries at the national level. Similar efforts for PG courses in fisheries are at an advance stage and the country may soon witness uniform syllabi at both UG and PG level.

Strengthening of infrastructural facilities: Availability of adequate laboratory and field facilities is essential for imparting effective practical training. While some colleges are fairly well equipped with necessary facilities, many others do not have even the minimum basic facilities. ICAR's World Bank-funded National Agricultural Technology project (NATP) provides opportunity for strengthening laboratory facilities and infrastructure. The SAUs and Deemed Universities should take advantage of one time catch up grant for renovation and remodulating of laboratories, replacement of old equipment and modernisation, strengthening of library and networking.

Faculty:An overview of higher education in fisheries indicates weak faculty both in quantity as well as quality along with a good percentage of sanctioned

posts remaining vacant in several colleges. Non-availability of qualified manpower in specialised frontier areas of fisheries has also been a general handicap in many of the fisheries colleges.

The ICAR grants sabbatical leave in order to encourage movement of scientists/teachers among SAUs, ICAR institutes and other organisations to help in development of expertise, the especially in less developed fisheries colleges/institutes.

The ICAR has also taken steps for improving the skills of existing faculty through refresher courses, higher training within and outside the country under the World Bank- supported Agricultural Human Resources Development (AHRD) project of ICAR. Faculty members chosen from some selected SAUs and ICAR deemed universities have already undergone training in reputed institutions abroad, in frontier areas of agricultural sciences including fisheries.

Admission and evaluation system: ICAR is conducting National Talent Search Examination to attract best students to UG courses in agriculture, including fisheries. In order to encourage diversification, ICAR has initiated steps to encourage students to move to different universities for their PG courses. So as to encourage higher standards, ICAR is recommending at least 50% external evaluation in the examination system in SAUs and deemed universities. Many of the SAUs have already implemented 50% external evaluation for their UG courses.

Instructional Material: Recognising the importance of standard instructional material, Education Division of ICAR has taken lead in identifying the subject areas and experts to prepare the text books for different courses. Work on some of them has already been completed and on the others at various stages of completion. The ICAR has also accorded priority attention to equip libraries with multi-media and CD-ROM facilities.

Accreditation: Of late, there has been a growing concern with regard to quality management in agricultural education at the Deemed Universities and SAUs established on the pattern of the Land Grant Colleges of USA. Certain minimum standards with regard to admissions, courses, faculty, infrastructure etc., need to be maintained to make our educational institutions internationally competent. It is in this context that ICAR has already constituted an Accreditation Board in 1996 to formalise norms and standards for improving quality of higher agricultural education. The accreditation process is intended to strengthen and sustain the quality and integrity of education, and improve transferability and marketability of students nationally and internationally. Accreditation of four SAUs has already been completed and others are in the pipeline.

Identification of course needs

UG and PG courses: Fisheries sector needs 'generalists' and also 'specialists' with the necessary skills to effectively participate in research, development, technology and technical management, teaching and extension. A generalist is the one who has acquired skills in all the three major sectors of the industry viz.: capture, culture and post-harvest technology. The four years B.F.Sc. courses, more or less as they exist now will be ideal for producing generalists. On the other hand a 'specialist' is the one who has specialised skills and knowledge in any one of the sectors or even in sub-sectors of fisheries. To become a specialist, one needs to pass through the two year M.F.Sc. course in specialised disciplinal branches of fisheries; or in some cases B.F.Sc. followed by a PG diploma provides proficiency to become a specialist. Ph.D. programmes directed primarily at advancement of knowledge and upgradation of personal capabilities in research are required to further fine tune the specialisations. Curricula of B.F.Sc. and PG courses should aim at providing sufficient exposure to ecology, gender and social equity in fisheries sector, fisheries management and employment generation. There should also be adequate provision for laboratory practicals, field visits, rural work experience and internship. In order to prepare our students to face global competitiveness, courses in WTO, TRIPS, patent laws and IT need to be offered.

Distance education: Distance education system offers a unique opportunity for ushering in a knowledge based society breaking the time and space barriers. This makes distance education well suited for meeting the major challenges in fisheries education such as access, cost, equity, quality and relevance. The distance education also offers immense scope for in-service education of teachers, trainers, researchers and extension workers. The potential of Information Technology(IT) needs to be harnessed in popularisation of distance education. Computer-aided community learning centres provide exciting possibilities for reaching fishers with suitable educational inputs. Efforts are on at CIFE to initiate certificate courses of distance education in areas such as 'freshwater aquaculture', 'brackishwater aquaculture' and 'fish processing technology' in collaboration with Indira Gandhi National Open University (IGNOU).

Training and extension: A holistic approach to the training and extension aspects in fisheries need to be adopted by channalising training efforts in various sectors after taking an inventory of trained personnel in each sector, additional requirements etc. Refresher training courses for state middle level officials need to be initiated by CIFE and Fisheries Colleges under SAUs. As recommended by the working group on fisheries for the Tenth Five Year Plan (GOI,2001). Total Aquaculture Technology (TACT) Centres may be established for demonstration and training preferably under the existing FFDAs. Publication of extension material in different languages for various categories of operatives and end users is required for creating technology awarness and for transfer of technology. The training and extension programmes should also focus on empowerment of fisherwomen.

Vocational Education: The aim of vocational education in fisheries is to prepare skilled manpower through appropriate curriculum in occupation related

areas with sufficient scope for self reliance and gainful employment. Self employment opportunities in fisheries include setting up running fish and prawn hatchery,undertaking fish seed production, fish and prawn culture, ornamental fish breeding, feed manufacturing, boat building, net making, fish processing, marketing etc. The vocational courses conducted in fisheries at present have not been very popular, due to poor acceptability of the courses by the students. Need based and location specific courses are to be identified in fisheries to increase acceptability of courses. Active participation of industry and Non Governmental-Organisations is also required for popularisation and sustainance of vocational courses. To make these courses successful, there is a need for restructuring of syllabi with greater emphasis on practical aspects and providing opportunity for academic vertical mobility.

Concluding remarks

As indicated in Table-1, based on the present intake capacity of 12 fisheries colleges and of CIFE,(Deemed University), the maximum number of B.F.Sc., M.F.Sc. and Ph.D students coming out of these institutions every year would be about 300, 170 and 50 respectively. Although professional fisheries education in the country started about three decades back, some of the State and Central government agencies are yet to prescribe fisheries degrees as essential qualifications for different posts of fisheries. Many of the future opportunities for employment and for that matter, demand of qualified fisheries persons in the state sector will come mainly through retirement. The will and decision of the states to change recruitment rules of fisheries technical staff to a minimum of fisheries science degree (B.F.Sc.) will determine the demand.

Agriculture, veterinary and animal husbandry departments insist on having graduates in the subject concerned for employment. It has to be so in the case of fisheries departments Further, the recruitment of scientists and college teachers for the posts in specialised disciplines such as genetics and biotechnology, nutrition, pathology needs to be done first from the fisheries disciplines and later trained in the required specialisation within or outside the country until such time these specialisations are available in fisheries. Such an approach will not only ensure job opportunities in fisheries departments, institutes and colleges to fisheries students, but will also develop a pool of trained manpower over the years in these areas. In the mean time, the state and central government agencies may be prevailed upon to amend thier recruitment rules to prescribe fisheries degrees, diplomas and certificates as the sole or atleast as a preferential qualification for fisheries posts as suggested by Shetty (1997).

While adhering to the right quality of teaching and training, major emphasis at UG level could be on enhancing skills through practical training so as to impart and to confer professionalism in a chosen area, besides providing rural work experience. PG programmes should lay major emphasis on imparting in-depth knowledge in science and modern techniques to develop human resources mainly for academic and research institutes. Curricula should be dynamic and need be based with inbuilt flexibility and revision at regular intervals. Further, it should be socially relevant and globally competitive.

Mushrooming of fisheries parallel courses in general universities is a matter of great concern. Some collages under general universities have started courses like B.Sc. (Aquaculture), B.Sc. (Industrial fisheries), PG diploma in Aquaculture etc., without having the minimum required infrastructure and other facilities required to conduct these courses. In order to maintain high standards, ICAR may formulate a mechanism in cosultation with UGC to bring an end to such courses and discourage general universities from offering them.

There should be a close linkage between fisheries educational institutes and fisheries industries. The industries should support research and infrastructure building efforts with massive funding as is done in some of the developed countries.

Curricula should be continuously reoriented to match with industrial needs. Infrastructure for higher fisheries education is cost intensive and no single institute can boast of all facilities and expertise. It is in this context close linkages between SAUs, ICAR Institutes and CSIR Institutes are likely to play an important role in the years to come.

, Today most Institutes of higher learning face severe resource crunch and therefore may have to generate income to meet part of their expenses. Augmentation of financial resources may be done through consultancies and funded projects without affecting the basic objectives and work of the institute/college. Also, fisheries colleges/institutes should strive hard to attract foreign students so that valuable foreign exchange of US $ 4000 per student can be earned annually and additional revenue generated (Abidi and Biradar, 2001).

The cost for imparting education in SAUs is above Rs.2 lakhs per student and is heavily subsidised at present. Further, the percentage of students who pursue higher education from UG to PG is 49.2% in India, while in France and Japan it is 18.3% and 5% respectively. In order to discourage this trend, option of enhancing fee at PG level may be explored.

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Table 1: Annual intake capacity of under-graduate and post-graduate courses in Fisheries Colleges and Institutions of India

Sr. No.	Name of the College / Institute	Annual Intake Capacity		
		Under Graduate	Masters	Ph.D
1.	College of Fisheries (University of Agricultural Sciences) Mangalore - 575002, Karnataka	40	25	10
2.	Fisheries College (Tamilnadu Veterinary and Animal Sciences University) Tuticorin - 628008, Tamilnadu	25	21	15
3.	College of Fisheries (Orissa University of Agriculture and Technology) Rangailunda, Berhampur - 760007, Orissa	16	8	4
4.	Fisheries College (Konkan Krishi Vidyapeeth) Ratnagiri, Maharashtra	40	12	3
5.	College of Fisheries (Kerala Agricultural University) Panangad, Kochi - 682506, Kerala	57	10	-
6.	College of Fisheries Sciences (G.B.Pant University of Agriculture and Technology) Pantanagar - 263145, Uttar Prasad	13	8	-
7.	College of Fisheries (Gujarat Agricultural University) Rajendra Bhavan Road, Verval - 362265, Gujarat	13	-	-
8.	College of fisheries (Rajendra Agricultural University) Dholi, Bihar	13	-	-
9.	College of Fisheries Science (ANG Ranga Agricultural University) Nellore - 524004 Andhra Pradesh	30	-	-
10.	College of Fisheries Science (Assam Agricultural University) Raha, Assam	20	-	-
11.	College of Fisheries Sciences (West Bengal University of Animal and Fishery Sciences) Kulia, West Bengal	30	20	-
12.	College of Fisheries, (Central Agricultural University) Lemberchera, Tripura	13	-	-
13.	Central Institute of Fisheries Education (Deemed University) Mumbai - 400061, Maharastra	-	50	15
	Total	310	154	47

Source: Accreditation for Quality Assurance in Agricultural Education. Indian Coucil of Agricultural Research. Krishi Anusandhan Bhavan, New Delhi (1998) and also revision based on personal communication.

Environmental Damage to Ennore Coast and the Pulicat-Ennore Complex

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Globalization brings in its wake so alled infrastructure development which ould however take place with attendant ecological damages. Quite often, ie location of such facilities is ill advised on ecological considerations. It is ell known that coastal waters provide ie resources for small scale fishermen eke out their livelihood and also provide food security for local population. he Ennore-Pulicat belt is well known or its fishery and its ecosystem with its iodiversity. Now,the Ennore Port, near hennai, has come up and a coal-fired thermal power plant (NCTPP) has also been commissioned. A huge petrochemical complex (Petro- Park) is being seriously promoted. Their impact on the fragile coastal ecosystem and fisheries has to be assessed.

The Ennore Port

It is stated that the new Ennore Port is meant mainly to divert coal unloading from the old(Marina) port to prevent pollution to the metroplis. This decision is illogical as it amounts to the transfer of pollution from one place to another. As feared by the coastal fishermen and environmentalists, the setting up of Ennore port has caused sea erosion wiping out many fishing villages and habitations. Some of the affected villages are Sathankuppam, near Pulicat (shifted to Edamani kuppam), Korakuppam, Andikuppam, Matha kuppam, Koonankuppam etc. Sea erosion has already affected the coast by ingressing up to 50m at Thereskuppam and Kasikoli. Vairankuppam and Thirumalinagar are also facing erosion. Ennore Creek (Backwaters) and adjacent marshy areas which were earlier nursery and feeding grounds of prawn and fish are seriously affected because of the port. Easterson, G. V. (CMFRI, Tuticorin) has recorded that the construction of Tuticorin fishing harbour had led to sea erosion at some points and shore elevation of others, causing changes in the morphology of the coast and the islands. He also stated that the mangroves of Vaipar and Vembar off Tuticorin were wiped out. Further, the particulate matter from coal handling is poised cause air pollution and affect the avian fauna off Pulicat-Ennore complex. It may be mentioned here that the P & O company was forced to pull out of Vadhavan (Maharashtra) after the Supreme Court prohibited the establishment of the mega port. (*The Hindu*, Survey of Environment 1999, p. 196-200).

Thermal Power Plant (NCTPP)

A 630 MW coal based thermal power plant has been established with no consideration for environment. Water is drawn from Pulicat Lake-Ennore backwater via the Buckingham canal. Drawal of huge quantities of water (50 mgd) will have the effect of depleting the lake of its water and make it shallower and reduce the area of the waterbody. Consequently, the fishery and biodiversity of the lake will be affected. Further, two major environmental damages will be caused by fly ash disposal and by the discharge of 'hot water' from the cooling system (Once through cooling).

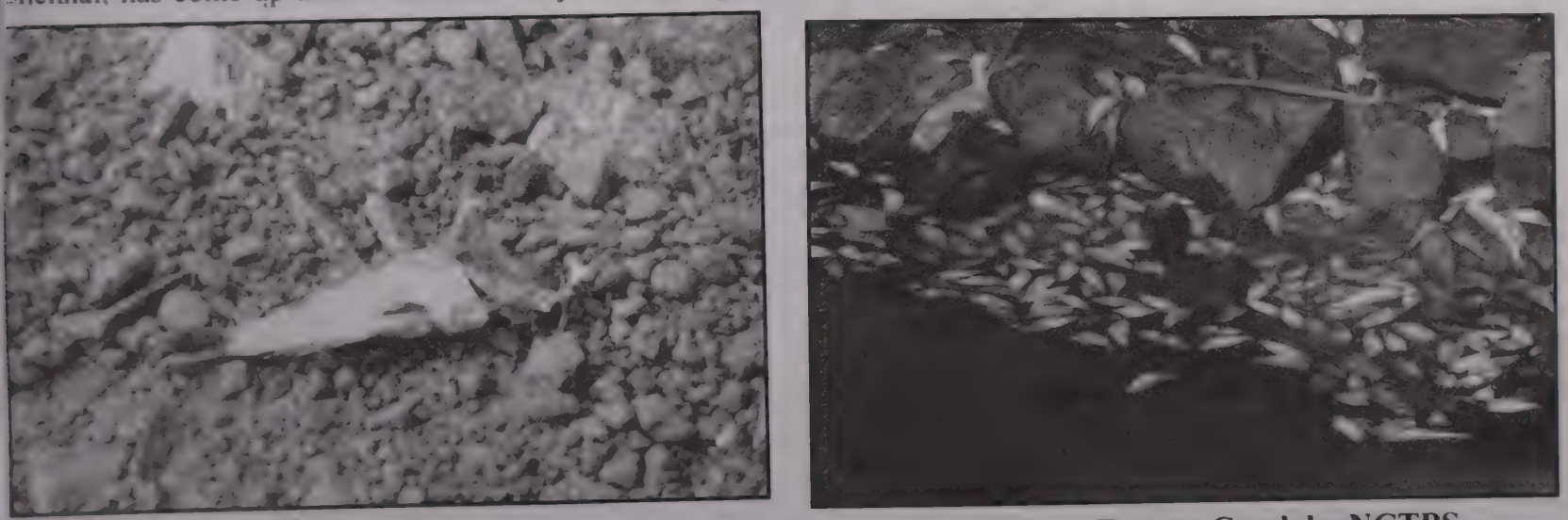

Fig 1: Destruction of Marine Resources due to intake of water from Ennore Creek by NCTPS (Thermal Pollution)

Heated Effluents (Thermal Pollution)

Heated effluents raise the temperature of the receiving waters from 2-40°C above ambient. 50 mgd of heated water is discharged into the Buckingham canal and the sea every day. This affects the thermal regime of Pulicat Lake-Ennore Creek and the inshore sea. De-

spite the claims of the authorities, our team has found the water at the confluence is too hot to touch. Temperatures above 35°c affect the aquatic life in different ways and usually at temperaturer above 40°c fish mortalities occur (Fig. 1). No marine life was noted in the vicinity of discharge of the thermal effluent from the coast. Dead crabs were noted even on the landward side of the sea. Dead fishes were noted in plenty. 2.8° C rise in temperature is permissible if the temperature does not exceed the monthly mean (D.I.Mount. *Jour.Water. Poll.Contr.Fed* **42**: 824, 1970). At higher temperatures, solubility of oxygen decreases while metabolic rates increase, thus forcing double disability on aquatic organisms. Accumulation of heat in the inshore sea and the lake water would raise the environmental temperature incrementally. Due to thermal shock unavoidable fish mortalities take place. Sub-lethal stress and changes in population structure will ensue. Resistance to diseases, parasites etc., is reduced, migrations stultified and biodiversity damaged. An overall rise of 5-6°C would render reproduction infructuous, affect development of eggs and eliminate fish. (Tarzwell, C.M., 1972, *Jour.Water.Pol.Contr.Fed.*, **42**:824-828). Modern coal based power plant of 500MW will discharge 4000 btu heat into the cooling system and the condensers will require nearly 800 cfs of water (Lof,GVG., & Ward J.C., 1970. *J. Water. Poll. Control.Fed.*Vol **40**). Accelerated eutrophication due to thermal pollution causes nuisance algae to flourish at the expense of diverse algal flora, causing oxygen depletion and fish mortality.

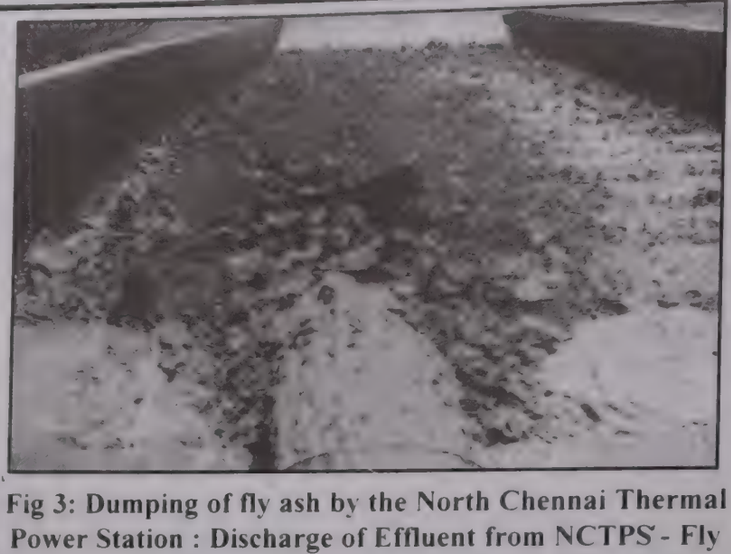

Fig 3: Dumping of fly ash by the North Chennai Thermal Power Station : Discharge of Effluent from NCTPS - Fly Ash Tank at Chappakkam, Ponneri Taluk, Thiruvallur

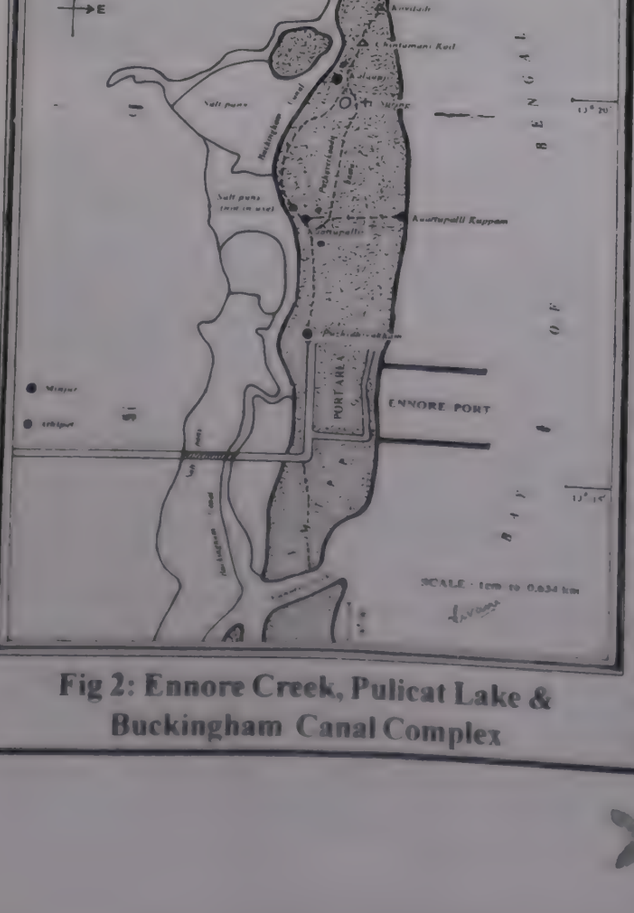

Fig 2: Ennore Creek, Pulicat Lake & Buckingham Canal Complex

Fly Ash

The NCTPP releases 3000 tpd fly ash into the environment, i.e., the Ennore Creek, Buckingham Canal, Pulicat Lake and inshore sea. Already the old South Ennore Power plant is discharging its fly ash into the coastal water (as a slurry). It is mind boggling to visualise big 'mountains' of fly ash that will result by the disposal of 3000 tpd for 365 days of the year. At present, the fly ash is dumped in 776 acres (310 ha) of land. A 1000 MW thermal plant requires 1000 acres of land for dumping fly ash i.e. one acre per MW power produced (Sankar Sen, Power Minster, W.B., *The Hindu*, 31-1-1998).

The soluble material from fly ash seep into the ground water and affect the quality of waters in the neighbourhoods or get added to the sea and the lake. Fly ash contains 11 ppm Arsenic, 9 ppm Cd, 120 ppm Cr, 100 ppm Cu, 35 ppm Pb, 150 ppm Ni etc. These accumulate in the water and soil and they get passed on to the food chain. The stack gases pollute the atmosphere with oxides of Nitrogen and Sulphur etc., and cause acid rains. Respiratory problems are caused by particulates in the atmosphere. (This is noted in the neighbourhood including Manali village). Fly ash settling in the bottom harms the bottom fauna. It clogs the gills of fish leading to their mortality. Photosynthetic productivity is affected. Since the NCTPP has become a *fait accomplii*, only ameliorative measures have to be enforced through pollution control measures. Thermal discharges should be regulated by proper cooling or heat recovery (The heat can be used for distilling sea water).

Fly ash is elaborately used in western countries especially in USA for making blended cements, for construction of roadways, for making ready-made concrete etc. It is also used as land fill. India at present produces 70-90 million t fly ash/yr which can be profitably utilised and at the same time helping in reducing pollution. There are reports that fly ash from Tuticorin Thermal plant has claimed coastal land and also created islands, as in Karapad Bay near Tuticorin. Earlier, in the late sixties, the Tamilnadu Fisheries Department objected to the disposal of fly ash and thermal effluents from Tuticorin power plant into the coastal waters but this fell on deaf ears.

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Pulicat Lake has an area of 46,000

Continued at P. 74

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Status of Fisheries Development in Tamil Nadu : Signficant Aspects

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The role of the fishery sector in the ational Economy is,in general, relavely limited. Fisheries sector, comared to other sectors of the National conomy, probably comes under the ost complex category. The complexy of fisheries sector stems from the inraction between nature, men and technology.

Fisheries sector, is the only sector hich offers cheap and good animal proein to the people, particularly to the conomically weaker sections of the soiety and thereby it is in an advantageous osition to ensure national food security. t is also a major source of foreign exhange in several countries, including ndia. The potential forward and backward linkages through boat building, construction of fishing harbours, fish processing etc., contribute further to diversification and strengthening of the regional and national economy.

Fisheries in the State Economy

The Net State Domestic Product (NSDP) of Tamil Nadu for the years 1995-'96 to 1999-2000 has an annual average growth rate of 0.329. The average annual growth rate of primary sector for the same period has been 0.337, while the average annual growth rate of fisheries has been 0.538. Thus the fisheries sector has been having a higher average annual growth rate for the period 1995-'96 to 1999-2000 which is above the primary sector's average annual growth rate. The increasing contribution of fisheries to National State Domestic Product (NSDP) could be seen from the fact that the share of fisheries income to NSDP which was 1.125 percent in the year 1995-'96 had increased to 1.841 percent in the year 1999-2000. The share of fisheries income in primary sector which was 5.398 percent in the year 1995-'96 has increased to 8.629 percent in the year 1999-2000. The share of primary sector in NSDP which was 20.841 percent in 1995-'96 had marginally increased to 21.332 percent in 1999-2000. This marginal increase has been mainly due to the higher growth rate of fisheries sector , a component of primary sector. The share of primary sector in State NSDP had declined in the year 1999-2000 compared to 1998-'99 which was 22.484 percent. The contribution of fisheries to primary sector which reached a maximum of 9.584 percent in the year 1997-'98 had declined to 8.629 percent in the year 1999-2000.

Demand Estimation

The average requirement of animal protein for a person is 30 g per day, of which, fish-based protein for a person should be 20 g according to the standards set by the Indian Council of Medical Research. Adopting this norm, the National Commission on Agriculture estimated the requirement of fish at 7.2 million tonnes by the year 2000 at 11 kg/annum per person for an estimated 654.78 million non-vegetarian population out of a total national population of 935.4 million. By using the same formula , the estimated minimum requirement of fish for Tamilnadu by the year 2000 was 0.49 million tonnes.

Supply

The supply of fish comes from marine and inland (including brackishwater bodies). The supply of fish at all-India level and for Tamilnadu in the year 1999-2000 had been 5.62 million tonnes and 0.48 million tonnes respectively. Hence the supply of fish for local consumption compared to the minimum demand, falls short by 1.93 million tonnes at the all-India level and by 0.06 million tonnes for Tamil Nadu. It may be seen that the Agricultural Commis-

TABLE - I : Net State Domestic Product (from 1993-'94 to 1999-2000)
(Factor cost at current prices Rs. in crores)

Year	*Primary Sector*	*Fishery sub-sector*	*NSDP*	*Ratio of Fishery to NSDP (in percent)*	*Ratio of Primary Sector to NSDP (in percent)*	*Ratio of Fishery sub sector to Primary Sector (in percent)*
'93-'94	13.55.244	49.597	51,64,850	0.960	26.240	3.660
'94-'95	15.08.339	65.957	61,69,537	1.069	24.448	4.373
'95-'96	14.66.009	79.132	70,34,341	1.125	20.841	5.398
'96-'97	16.52.708	1.10.207	79,78,078	1.381	20.716	6.668
'97-'98	20.03.777	1.92,040	93,30,852	2.058	21.475	9.584
'98-'99	23.80,192	2,13,154	1,05,86,193	2.014	22.484	8.955
'99-'00	24.66.918	2,12,873	1,15,64,416	1.841	21.332	8.629

Source: State Planning Commission. column 1.2.3. & 4.

sion estimated that the fish production in India in the year 2000 would be 8.0 million tonnes where as the actual production in the year 1999-2000 was only 5.62 million tonnes.

Exports

Apart from meeting the domestic consumption, the State gains significantly from the marine products exports. This is revealed in terms of the increase in the quantity and value of exports over years. Tamil Nadu is one of the major marine product exporting States. An analysis of data on marine exports in terms of quantity from the State and at national level shows a linear growth rate of 0.0847 and 0.0798 respectively for the period 1970-2000 (Table II). In terms of value, the linear growth rate has been 1.658 and 2.163 respectively for India and Tamil Nadu. The all-India average annual export growth rates for the periods 1990-2000, 1990-'95 and 1996-2000 in terms of quantity were 16.22 percent, 30.11 percent and 3.95 percent respectively. Exports from the State for the same periods were 6.55 percent, 1.36 percent and 9.68 percent respectively. The analysis also shows that per unit realisation from fishery exports of the State was far higher than that of the all-India per unit realisation. Per unit realisation from marine products exports for the entire nation in 1999-2000 was Rs.149.16/kg, while for Tamilnadu it was Rs. 336.53/kg in the same year. The average annual growth rate in per unit realisation of fish export for the State for the period 1990-2000 had been 50.52 percent. This is far higher than the all-India average annual export growth rate of 14.75 percent for the same period. This trend is likely to continue in the future provided there is significant value addition to fish and fishery products.

The above analysis also shows that the long term linear growth rate for the State has been far higher than all- India linear growth rate for the period 1970-2000 both in terms of quantity and in terms of value. However, the growth rate in the State during the last decade in terms of quantity had been far below the growth rate of all-India fish exports. The average growth rate of marine products exports from the State, in terms of quantity during the second half of the last decade had been better compared to the first half. Though in terms of quantity the average annual growth rate had been low compared to the all-India average growth rate, per unit realisation growth rate in the State had gone up three times compared to the all-India per unit realization growth rate from export of fish and fishery porducts.

Policy and Performance

The objectives of economic planning are removal of poverty, building of a modern society, making maximum use of science and technology and attainment of self-reliance. The investment programme and the policy envisaged in this context, relate to the goals that have been set in the plans. Formulation of a realistic fishery development policy in the country has always been a difficult and complex matter due to uncertainties surrounding natural resources, potential markets and the inter-dependence of fishery sector with other segments of the economy.

The performance budget of the Tamilnadu Fisheries Department for the period 1990-'91 to 1999-2000 has been used to study the policy, programmes and its implementation. The State Department of Fisheries has developed the marine fisheries sector by providing thrust to introduction of mechanised boats, and fishing nets made out of synthetic twine for augmenting the production. This initiative, which transformed the fish production scenario of the State upwards, was subsequently followed by motorisation of traditional fishing crafts by offering incentives by way of subsidies towards installation of outboard motors and inboard engines. These measures upgraded the socio-economic conditions of fishermen significantly. These have been followed up by several measures such as housing, insurance etç.. to further strengthen the socio-economic status of marine fisherfolk in the State. The analysis of the Performance Appraisal Report of the State Fisheries Department shows that the share of expenditure on socio-welfare measures constitutes a major portion i.e., 47 percent of the total fisheries budget. (Table-III) The expenditure on relief ,neasures, which was 90 percent of the socio-wel-

TABLE – II : Supply and Demand for Fish in India

Year	*Population (million)*		*Non. Veg. Population (million)*		*Total Supply (million tonnes)*		*Supply for domestic consumption (million tonnes)*		*Demand at 11 kg/annum person (million tonnes)*		*Shortfall (million tonnes)*	
	India	*TN*	*India*	*TN*	*India*	*TN*	*India*	*TN*	*India*	*TN*	*India*	*TN*
1971	547.0	-	382.9	-	1 8	-	1.61	-	4.21	-	2.60	-
2000 *(estimated)*	935.4	63.6	654 78	44.51	8.0*	-	6.75*	-	7.2	-	0.7	-
2000 *(actual)*	-	-	-	-	5 61	0 48	5 27	0 433	-	0.49	1.93	0.06

*Estimated supply by the National Commission on Agriculture

Source Report of the National Commission on Agriculture-Part –III, fisheries, Government of India, New Delhi, 1976

e expenditure has declined to 50 per-nt over the period 1990-2000, which a positive feature. Despite this decline, e performance appraisal reports also ow that, while expenditure on socio-elfare measures has increased over the st decade, the schemes for frastructural and technology develop-ent and updating have been found to not there. On the research and de-elopment aspect also, the State Fish-ies Department had not drawn any per-pective plan for dove-tailing the rogrammes for the benefit of fishermen d to transfer the technology especially the fields of fish culture and seed pro-uction. The expenditure for promotion f inland fisheries which was around 20 percent in the year 1990-'91 had declined to around 13 percent in the year 1999-2000 though in terms of absolute amount there had been an increase in expenditure on inland fisheries. The inland fish production has not increased as it should have been, in spite of efforts by the government to promote inland fish production. The expenditure of the government on fisheries education, training and research had remained almost static during the last decade around 11 percent, but the expenditure on fishery cooperatives had increased very much from around 2 percent to 16 percent during the decade implying that cooperatives had become dependent on government finance.

Conclusion

Export growth in Tamilnadu has declined in terms of quantity though in terms of value there has been a sharp increase during the 1990s. Stress should be laid on value-added exports which would create job opportunities and increase export earnings.

Provision of reliable and good infrastructure facilities can help the fishermen, the wholesalers and other intermediaries related to the production and marketing systems. Investment for development of both marine, inland and aquarium fish culture to tap the potential is far from adequate. This is espe-

Table-III : Exports from India and Tamil Nadu (1970 - '71 - '99 - 2000)

Qty:Tonnes
Value:Lakhs

Year	*India Qty.*	*Tamilnadu Qty.*	*Share of Tamil Nadu to total (in %)*	*India Value*	*Tamilnadu Value*	*Share of Tamil Nadu to Total (in %)*	*India Per unit realisation*	*Tamilnadu per unit realisation*
'70-'71	35,883	6,329	17.63788	3,507	238.58	6.80265	9.77343	3.77
'71-'72	35,523	5,511	15.51389	4,455	173.51	3.894725	12.54117	3.15
'72-'73	38,903	'2.571	6.608745	5,972	221.47	3.708473	15.351	8.61
'73-'74	52,279	5,719	10.93938	8,951	803.75	8.979444	17.1216	14.05
'74-'75	45,099	3,922	8.696423	6,840	750.32	10.96959	15.16663	19.13
'75-'76	54,463	6,389	11.7309	12,453	1,668.87	13.40135	22.86506	26.12
'76-'77	66,750	8,231	12.33109	18,912	2,583.95	13.66302	28.33258	31.39
'77-'78	65,967	8,009	12.14092	18,095	2,400.09	13.26383	27.43038	29.97
'78-'79	86,894	10,033	11.54625	23,462	2,870.42	12.23434	27.00071	28.61
'79-'80	86,401	8,294	9.599426	24,882	2,983.27	11.98967	28.79828	35.97
'80-'81	75,591	6,751	8.930957	23,484	2,212.06	9.419435	31.06719	32.77
'81-'82	70,105	4,833	6.893945	28,601	1,728.87	6.044789	40.79738	35.77
'82-'83	78,175	6,871	8.789255	36,136	2,805	7.762342	46.22	40.82
'83-'84	92,187	16,185	17.55671	37,302	4,149	11.12273	40.24	25.63
'84-'85	86,187	18,792	21.80375	38,429	5,128	13.34409	44.59	27.29
'85-'86	83,651	17,421	20.82581	39,800	6,012	15.10553	47.58	34.51
'86-'87	85,843	18,053	21.03025	46,067	6,877	14.92826	53.66	37.9
'87-'88	97,179	13,832	14.23353	53,120	6,619	12.46047	54.66	50.52
'88-'89	99,777	15,331	15.36526	59,785	10,294	17.21837	59.92	67.32
'89-'90	1,10,843	18,501	16.69118	63,499	9,975	15.70891	57.29	53.81
'90-'91	1,39,419	27,340	19.60995	89,337	16,588	18.56789	64.08	60.67
'91-'92	1,71,820	25,048	14.57805	1,37,589	23,053	16.75497	80.08	92.04
'92-'93	2,09,025	30,963	14.81306	1,76,856	33,745	19.08049	84.61	115.42
'93-'94	2,43,960	20,473	8.391949	2,50,362	46,188	18.44849	102.62	225.41
'94-'95	3,07,337	28,831	9.380908	3,57,527	78,010	21.81933	116.23	282.19
'95-'96	2,96,277	31,330	10.57456	3,50,111	71,918	20.54149	118.17	229.55
'96-'97	3,78,199	40,878	10.8086	4,12,136	1,07,567	26.09988	108.97	255.8
'97-'98	3,85,818	41,052	10.64025	4,69,748	1,22,005	25.97244	121.75	297.24
'98-'99	3,02,934	45,026	14.8633	4,62,687	1,37,901	29.80438	152.73	306.27
'99-'00	3,43,031	43,464	12.6705	5,11,667	1,46,269	28.58676	149.16	336.53

Source: Marine Products Export Development Authority, 2000

Tamil Nadu Fisheries Development : Action Matrix

Problem	*Impact*	*Solution*	*Policy issues*	*Institutional intervention/changes*	*Result/outcome*
1 Overfishing in coastal areas	Unable to maintain the sustainability of fisheries	Improvement of community management of fisheries	- Incorporation of local fishing arrangements/agreements in to the Marine Fishing Regulation Rules 1983. - Delete certain provisions of the Indian Fisheries Act to suit the present day needs. - Modify provisions relating to demarcation of zones to facilitate traditional fishermen to have his share of resources.	Deploy block level extension workers to educate fishermen in community management of coastal resources.	1 Ensure sustainable fisheries 2 Ensure an appreciable increase in income of fisherfolk
2. No data base for planning, managing fishery	-Non-assessment of resources -Production below the potential	- Estimation of resource base- blockwise/coast wise/depth-wise - water retention period and average depth (includes waterbodies only)	-	Block level extension workers to participate in development of resource base.	- Creation of data base for proper planning and management of fishery - Better and accurate planning of fisheries - Better management of fisheries
3 Open access to reservoir fisheries	No control over production	Management plan to be drawn up involving stake holders	- Decentralization of administration. - Delegation of powers to front line officers of the Department	The Dept of Fisheries should be catalyst for development of fisheries	- An appreciable increase in fish production
4 Multiple ownership (inland fisheries & short-term leasing)	Less production	Leasing rights to be issued by a single agency irrespective of the ownership. Lease period should be atleast for a minimum period of three years to ensure lessee's involvement in management of waterbodies	- Revenue board standing orders to be amended - Relevant Govt. orders to be amended	The Dept of Fisheries should be final authority in all fish licensing/leasing matters	- Total commitment and involvement of stake holders in all fisheries management plans
5 No institutional tie-up right from production to consumption	- Lower share of consumer rupee to the producer - Higher unit price for the consumer - Low profit margin for the seller	Integrate all institutions involved in fish and fisheries	A central agency for policy formulation and monitoring	Outside Expert from academic institution	- Better co-ordination for policy planning - Introduction of new technologies to benefit stake holders is possible
6 Non-demarcation of coastal waterbodies for aquaculture	Aquaculture especially coastal aquaculture adversely affected	Demarcation of coastal zones/waste lands to be undertaken on a war-footing	Steps to be taken to modify amend environmental Ministry's notification - 1993 to incorporate Aquaculture also as water-based industry	The present aquaculture authority may be enhanced to include members from the farming community as well as the State Administration	- Revival of aquaculture in the State - Ecofriendly aquaculture is possible -Increase in production and export earnings of shrimp
7 Bottlenecks in fish seed and fish production	- Low capacity utilization - Less production	Budgetary ceilings to be synchronized with production seasons	-	-	- Effective capacity utilization - Increase in production
8 Budgetary allotment for infrastructure inadequate	- Lack of infrastructure - Low production	Marginal adjustment in allotment of funds between welfare schemes and production schemes (including infrastructure)	Realignment of policy objectives	-Institutional interventions can be confined to infrastructure development - The Director of Fisheries can intervene in fisheries research infrastructure development and allied catalyst role for fisheries development - The on-going welfare programmes to be looked after by the appropriate State Department - Sufficient funds available for development - Increase in prodn	Strengthening infrastructure for achieving higher production

TABLE - IV : Scheme wise expenditure (in Percentage)

Name of the Scheme	*Year*		
	1990-'91	*1995-'96*	*1999-2000*
irection and administration.	7.42	5.73	5.29
esearch	3.11	2.15	2.28
ducation and Training	7.70	7.07	8.09
ıland Fishery	13.97	11.07	11.05
rackishwater Fish culture	3.37	1.70	1.71
ishing Harbour and landing acilities	2.22	3.51	3.38
ommercial Fisheries	2.14	0.54	0.35
rocessing Preservation and Marketing	0.78	0.48	0.25
Iarine Fisheries	6.00	2.77	3.64
isheries Co-operatives	2.37	9.41	16.42
ocio-Economic Measures	45.81	52.24	46.75
nformation and Statistics	1.08	0.94	0.65
ıssistance to TNFDC	0.00	1.51	0.16
ıssistance to FFDA	4.02	0.88	-

ally so in the case of inland food fish d aquarium fish production. Considing the potential, there is vast scope r increasing the inland food fish uarium fish production, if adequate vestment is made.

The surest welfare measure for people is the opportunity to keep themselves busy . In the long-run, welfare measures cannot be self-sustaining. The appropriate mix between infrastructure development and welfare measures must be kept under constant review, taking note of the fact that at any given time, even in the absence of subsidies, infrastructure development is likely to confer different advantages to different sections in the society over a time period. Without infrastructural improvements the condition of the poor cannot be improved. The decision on the appropriate allocation of resources between infrastructural development and welfare measures is therefore, simultaneously an inter-class and inter-temporal choice and is consequently one of the most crucial politico-economic choices in the context of development. It would also be worthwhile if an analysis of the developmental needs of fisheries sub-sectors is taken up. It is essential that, while framing policies for fisheries development, certain basic issues are addressed in a holistic manner. An action matrix is given on the preceding page for identifying the basic issues, constraints and solutions for the development of fisheries sector in Tamilnadu.

Present Status of Fisheries Development in Assam : Strategy Suggestions for Conservation of Fish Bio-Diversity

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Assam, the second largest Indian State of North Eastern region, has vast untapped potential of fishery resources in terms of fish germ plasm. It has about 200 fish species. The State has several rivers with a total length of 4,820 km. Apart from this fishery resource, the State is endowed with 100,000 ha *beel (ox bow)* lakes, 1,710 ha of reservoirs and about 30,000 ha lowlying areas/ swamps, 25,423 ha ponds/tanks and about 1,200 ha of paddy-cum-fish culture area. The gross value of fish production in the State has been estimated to be in the order of Rs. 620 crores. The fisheries sector of the State provides full and part time employment to about 475,000 fishers. More than 90% of the population in the State relish fish as an essential supplement to their staple food. Fish production from all sources during 2000-'01 was 1.6 lakh mt leaving a demand-supply deficit of 64,000 t. The per capita availability of fish in the State is 7.3 kg against the requirement of 11.0 kg per annum. Out of 2,19.730 mt of fish production in all the N.E. States in 1999-2000, Assam's contribution was 1,59,770 mt, about 73% of the total fish production of the region. So as to reduce the demand-supply gap, the State imports fish from other states like Andhra Pradesh, Uttar Pradesh, Bihar, West Bengal, and Madhya Pradesh. It is estimated that Rs.20.00 lakh worth of fish is imported daily into the State. The heavy expenditure on transportation and other costs because of imports from distant places have pushed up the cost of fish in the State. The people of the State can be saved from the high cost of fish, by expanding and intensifying fish production in the State.

Assam produced 1,485.68 million major carp fry in 2000-'01, next only to West Bengal. 123 hatcheries and 250 hapa fish breeders in the State produce seed, but the non-availability of quality fish seed to the farmers at appropriate time is the main causative factor for improper growth of aquaculture in the State. It is assessed that due to defective management of the broodstock and improper nursery and rearing pond management practices, the realisation of healthy fish seed for stocking purpose is very poor in the State.

Efforts have been made to identify areas of intervention for stepping up production, and in this context technologies like composite fish culture and paddy cum fish culture,in the main, were chosen for adoption. In addition, it is observed that there is tremendous scope for integrated fish culture activities like duck-cum-fish culture, horticulture with fish culture, taking up innovative fish culture technologies like running water fish culture by diverting hill streams to production-conducive areas etc. Promoting freshwater prawn culture by importing seeds from West Bengal is another area that emerged to be a very promising activity to be undertaken in the State.

Development of culture based capture fisheries in reservoirs and *beels*, and efficient management of existing lakes/ open waters have to be further promoted for narrowing the gap between fish supply and demand. In this respect, coordinated efforts are needed by all the concerned authorities. Another aspect is that there is ample scope for production of ornamental fishes both for domestic and export market. It is reported that there are about 189 species of fish in the entire N-E region, having ornamental features out of available 267 fish species. Out of the five billion US $ ornamental fish trade globally, India's share is just 0.007%. India exported ornamental fishes worth Rs.158.23 lakhs last year, of which a component of Rs.142.56 lakhs was from West Bengal. Of this, it is estimated that ornamental fishes worth more than Rs.110.00 lakhs was exported from N.E. region through Kolkata airport. With the expected upgradation of Guwahati airport into an International airport, ornamental fish export could get a boost as the exporters can directly send the consignments to foreign countries avoiding transhipment in Kolkota.

The capture fisheries, the main source of fish production in Assam, suffers due to unsystematic construction of embankments, over exploitation of fish, destruction of catchment areas, indiscriminate killing, siltation, deforestation, pollution etc.

The conservation programmes require the participation of government agencies, general public, organisations of fishermen, scientists, planners and administrators. The conservation planning largely depends on well-investigated scientific data, which is lacking in Assam. The main constraint for conservation of fish bio-diversity is identified as poaching. Controlling human poachers to prevent over fishing is a difficult task in the present socio-economic condition of the State, as is also the problem in other States. Conservation has to take care of the rehabilitation of some endangered species and meticulously protect the intra-specific genetic variation in some economically important species as often come across. Conservation of genetic variability is essential for the welfare of the organisms, which imparts adaptive ability in them to survive under varying environmental conditions. The simplest approach of preservation is proclamation of certain stretches of rivers, tribu-

ies, *beels*, hill streams or reservoirs sanctuaries. For sanctuary manage-nt, public awareness, participation d co-operation are of vital importance. e legislative measures like prevention fishing during the breeding season or gulation of mesh size of the nets to low small fish to escape would have be followed strictly. Specially, operation of mosquito nets for catching spawn fry during breeding season would have to be banned. The setting up of fish sperm bank, however, is needed to serve the purpose of bio-diversity conservation to a certain extent. The conservation of "genes" in gene libraries needs to be initiated. National responsibility towards bio-diversity conservation is for ethical, economical and ecological reasons. Arousal of conservation consciousness in the minds of the citizens is very essential. The most important need in this context is the funding and encouragement of bio-diversity assessment endeavour, which holds the key to the whole exercise of bio-diversity conservation.

National Deepsea Fishing Policy

The deepsea fishing industry is con-derable hosted over the inordinate de-y in the announcement of the national eepsea fishing policy by the Union epartment of Animal Husbandry and airying. In October 1999 itself the eputy Director General (Fisheries) CAR announced in the meeting in isakhapatnam that the committee onceren submitted to draft policy to the epartment. The industry is puzzled ver the delay of six months in the inalisation of the policy. There is a omperhension that the recent permission accorded by the Ministry of Commerce for the import of second hand vessels with a arrangement of payments of deffered basis is responsible for the delay. It is rumoured that there is a loby at work for the inclusion of this system of importing vessels including used ones as part of the policy, which has been causing delay, as the issue is various other implications. The President of AIFI, Mr. T. Raghunath Reddy, Recently met the Senior Officers in the Union Department of Animal Husbandry and Dairying and also held a press conference to bring out the problems faced by the industry because of the long delay and also emphasised the likely adverse effects if growing payments to use vessels on the national industry, the reason for this is stated to be left all these vessels would continue to be operated by foreign crew and with a good percentage of export earnings into foreign owners, there by doing to Indian crew and also reduction in export earnings.

Pilot Tuna Project

The Pilot Tuna Project, for the installing of tuna monofilament longlining equipment on the shrimp trawlers of two deepsea fishing companies located at Visakhapatnam with Japanese Colloberation organised by MPEDA in association with the Association of Fisheries Industries, which understood to have now gained momentum, one consignment of equipments has already reached Visakhapatnam in second and final consignment is expected to reach Visakhapatnam in early May. With the arrival of the equipments the installing are expected to commissions on the two shrimp trawlers and the work is expected to completed well before the forthcoming season. There is anticepation with the results would be successful and these would be the way for similar installing of atleast another 25 shrimp trawlers, and there suitable finance arrangements for which various avenues are being expired.

Status of Fisheries Development In Orissa

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The State of Orissa, situated on the east coast of India, has a coastline of 480 km. The marine fishery wealth off the coastline is known for its richness, particularly in respect of shrimp resources. The Chilika lake, situated in the State, is the biggest brackishwater lagoon of the country that supports a major fishery. The State is also blessed with also brackishwater, freshwater riverine resources, and lentic resources including tanks, ponds etc.

Fish culture is an age-old practice in the State. With around 80% fish eating population, the per capita consumption of fish in the State is 7.71 kg., as against national average of around 9 kg. The compound growth rate in inland and marine fisheries sectors of the State during 1999-2000 had been 8.98% and 7.16% respectively as against 6.93% and only 2.7% respectively at national level. With Rs.379 crores of export income from fisheries sector during 2000-2001, the sector is on an ascending mode in the State. A broad picture of the fishery sector of the State is furnished in the adjacent Tables and Tables on the next page.

Table 1 : Aquatic Resources

1.1	Coastline	480 km.
1.2	Continental Self	23,830 Sq. km.
1.3	Estuaries	2,97,850 ha.
1.4	Backwaters	8,100 ha.
1.5	Brackishwater lagoon.	79,000 ha.
1.6	Brackishwater culturable area	32,587 ha.
1.7	Freshwater culturable area (Tanks & Ponds)	1,16,280 ha.
1.8	Reservoirs	2,56,000 ha.
1.9	Lakes & Swamps	1,80,000 ha.
1.10	Rivers and Canals	1,55,400 ha.

Table 2: Human Resource in the Fisheries Sector

Sl.	*Particulars*	*Inland*	*Marine*	*Total*
2.1	Fisher Villages	2956	329	3285
2.2	Fisher Population			
2.2.1	Male	2,20,876	94,491	3,15,367
2.2.2	Female	1,90,749	86,180	2,76,929
2.2.3	Children	2,51,222	1,52,101	4,03,323
2.2.4	Total	6,62,847	3,32,772	9,95,619
2.2.5	Active fishermen	1,18,172	86,312	2,04,485

Table 3: Development Status under Culture Sector (2000-2001)

3.1	Freshwater Tanks & Ponds	51,794.85 ha. covering 1,26,106 beneficiaries
3.2	Brackishwater Tanks & Ponds	12,708.82 ha. covering 9,197 beneficiaries

Table 4: Fish Seed Production (in lakhs)

Sl.	*Particulars*	*Spawn*		*Fry*	
		1995-96	2001-02	1995-96	2001-02
4.1	Departmental Production	4,133.35	5,214.25	788.63	937.635
4.2	O.F.D.C. Production.	3,304.00	3,687.00	662.40	803.02
	Total Public Sector Prodn.	**7,437.35**	**8,901.25**	**1,451.03**	**1,740.655**
4.3	Private Sector	1,184.00	3,551.00	670.16	1,754.45
	Total Production	**8,621.35**	**12,452.25** (Record prodn.)	**2,121.19**	**3,495.11** (Record prodn.)

Future Thrust Areas

1) A new Reservoir Fishery Policy is under active consideration of the State Government. The approval of the policy will facilitate fishery development in the reservoirs of the State having an extent of 2.6 lakh ha; 2) The enactment of Orissa Fisheries Conservation Act, now under processing, will strengthen responsible fishing; 3) Increasing production of both fish and freshwater prawn per unit area through an intensive extension drive for effective results; 4) Monoculture of freshwater prawn which is limited to a few small pockets only to be transformed into a polyculture system on a wider scale with major carps and popularised; 5) Ensuring eco friendly culture practice in 283 ha. Shrimp culture water area in Kendrapara district under World Bank Assistance; 6) Privatisation of departmental farms and establishment of more and more fish seed hatcheries in Private sector; 7) Implementing more fishermen welfare oriented schemes including housing, coverage of more fishermen under schemes like Accident Insurance and Saving-cum-Relief; 8) Motorisation of more of existing traditional crafts to ensure safety and to generate more income to fishermen; 9) Popularisation or Ornamental fish culture; and 10) Saving Chilika, the largest brackishwater lagoon of Asia through different programme including fishery conservative measures (The total fish production of the lake of 8926 tons during 1986-87 has come down drastically to nearly 1274 t, although again in the increasing trend. It was 4889 t. during 2000-01).

Table 5: Fish Production in (tonnes)

Year	Inland			Marine	Total prodn.	Contribution to National Sector
	Total fresh water	Brackish water	Total Inland			
995-96	1,21,941	12,902	1,34,843	1,23,200	2,58,043	5.21%
000-01	1,25,114	13,442	1,38,556	1,21,086	2,59,642	NA

Table 6: Export of Fisheries Products

Year	Quantity (t) (+)	Value Rs. Crores	Share by value		Contribution to Nation by value
			Shrimp	Scampi	
990-91	3,841.00	53.53	100%	-	5.96%
995-96	7,070.00	176.39	95%	1.96%	5.0%
000-01	10,644.5	379.099	93.2%	3.2%	6.01%

Table 7: Orissa Marine Fishing Regulation Act (OMFRA)

Item	During the year	Up to date
No. of illegally operated boats seized (Nos)	12	485
Amt. of revenue (Fee & Fine) collected (Rs.)	15,87,121	1,35,74,043/-

Table 8: Welfare Schemes under Operation

Scheme	Coverage of fishermen (Nos.)	Target for 2001-02
Accident Insurance	1,20,000 (Annually) & so far Rs. 116.895 lakhs for 514 nos. of claims received	1,20,000
Saving-cum-Relief	45481 nos. amounting to Rs.127.184 lakhs (up to 95-96 only & since then no allotment)	500 nos.
Motorisation of country craft	3753 nos. amounting to Rs. 465.4 lakhs	885
Low cost houses	In 12 villages 432 houses & 8 tube wells	-

Building of Peninsular Aquaculture Division on CIFA Opened in Bangalore

Dr. Panjab Singh, Secretary, DARE, Government of India and Director General, ICAR inaugurated, on 26th April 2002, the Laboratory and Office Complex of Peninsular Aquaculture Division of Central Institute of Freshwater Aquaculture, Bhubaneswar, at Hessarghatta Lake, Bangalore. This inauguration strengthens facilities for the research work related to reservoir fisheries etc., now being conducted at the Peninsular Aquaculture Division of CIFA at Bangalore.

Diesel Oil supply to Fishing Boats: Reliance steps in

In the wake of the withdrawal of the Administered Price Mechanism (APM) in respect petroleum products, Reliance industries has stepped in to supply oil to fishing vessels at somewhat lower prices. The company has already commenced diesel oil supplies at Rs. 15/- per litre, it is learnt. Public sector oil companies are reported to be working on a strategy to checkmate this situation. Mechanised boat operators believe that they can save around Rs. one lakh a year per boat because of taking supplies of diesel oil from Reliance Company.

Ban on the Culture of Exotic Prawn

It has been reported that some of the aquafarmers are carrying out the farming of American White Shrimp, *Penaeus vannamei*, exotic species, by sourcing the seed illegally suppled by the hatcheries abroad. This species, though belongs to the 'White Shrimp' group, no scientific data is available to prove that *V.Vannamei* is superior to the Indian White Shrimp, *Penacus indicus* in it's growth profile and disease resistance.

It is gathered from various sources that this species is highly susceptible to all the known pathogens affecting shrimp. This particular species is far more vulnerable to viral pathogens that Indian White Shrimp and is prone to attack by both DNA and RNS viruses such as i) BP - Baculovirus, ii) MBV - Monodon Baculo Virus, iii) IHHNV - Infectious hypodermal and hematopoleric virus, iv) HPV - Hepatopancreatic parve virus and v) WSSV - White spot syndrome virus - (DNA Viruses) & (i) YHV - Yellow head virus) and (ii) TSV - Taura Syndrome Virus (RNA Viruses).

Introduction of new exotic species like P.vannamei from a totally different geographical location, i.e., from the Western Hemisphere to India is extremely dangerous, as it is more vulnerable to pathogens due to its lower adopting resistance. It may also act as carriers of new viral pathogens in the place of introduction, resulting in alarming disease problems.

All the aquafarmers are, therefore, requested not to stock this species by sourcing seed illegally from abroad. Farmers should also take note that introduction of any live animal, including this species, in India needs legal permission from the concerned authority of the Government of India, and any violation of this kind can invite strong legal action.

Highlights of Fisheries Development in Andhra Pradesh

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Andhra Pradesh is playing a lead role in the development of Fish/prawn production in India. The waterspread area of inland water sources like reservoirs, perennial and long seasonal tanks is over 6 lakh ha. Freshwater fish culture is undertaken in over one lakh ha of ponds constructed exclusively for the purpose. The estimated production potential is 8 lakh tonnes from inland fishery resources and 4 lakh tonnes from marine fishery resources. In addition, the brackishwater sector, with 1.50 lakh ha of suitable area for culture, has a production potential of 0.75 lakh tonnes of fish/shrimp.

The core function of the department is to enhance fish/prawn/shrimp production by harnessing the natural resources in a sustainable manner. Keeping in view the vast potential for the development of fishery in the State and its contribution to the State economy, the fisheries sector is identified as a Growth Engine under Vision-2002 and is one of the six growth engines identified under Agriculture and allied sectors. And it is envisaged that fish production will be four times of its current level, reaching a level over 10 lakhs tonnes per annum.

Among the various States of India, Andhra Pradesh ranks FIRST in Coastal Aquaculture, also FIRST in Freshwater prawn production, SECOND in Inland fish production and FIFTH in Marine fish production.

The State has a coastline of 974 km., and a continental shelf of 0.33 lakh sqkm. The potential of the marine fishery wealth is estimated as 4.00 lakh tonnes. While fishery wealth upto 50 fathom depth is optimally exploited, the deep sea fishery wealth is relatively less exploited. There is good potential for exploitation of tuna fish in the Indian EEZ and this fish has export potential also.

To improve the exploitation of marine fishery wealth, a multi-pronged approach is adopted. This consists of introduction of modern fishing crafts like FRP motorised crafts and motorisation of traditional crafts, dissemination of satellite technology on identification of potential fishing zones (PFZ)and taking up Tuna fishery project. All these will add to the Gross State Domestic Product.

On the inland fisheries front, the State of West Bengal is in the first position and Andhra Pradesh occupies second position. In order to improve the inland fish production, new approaches in stocking with fingerlings and yearlings, are planned to be adopted. There is good scope to increase the area under freshwater prawn farming (scampi) as it is an alternate culture species for Tiger shrimp and has good export demand also. It is hardy and can also be cultured in long seasonal tanks.

The position of the State among the Indian Coastal States has improved from Seventh to Sixth position in marine fish production in 1999-2000 and further to Fifth position in 2000-2001. Similarly, the position in inland fish production has improved from third to Second position in 2000-01.

The status of fish production in Andhra Pradesh and the share of Andhra Pradesh among the various States of the country during 2000-01 is given Tables 1 and 2.

Highlights

The significant highlights of Fisheries sector of Andhra Pradesh are as follows:

a) Fish Production : The fish production in the State has improved appreciably reaching a level of 5.89 lakh t during the year 2000-01, and this is 10.41% of the total fish/shrimp/prawn production of 5.6 lakh t in the country. The fish/shrimp/prawn production in the period from April to December, 2001 was 4.91 lakh t and it is anticipated that the target of 6.70 lakhs t for the year 2001-02 will be achieved. The Chief Minister of A.P has approved of a programme to take up stocking of 293.5 lakhs of fish seed by the farmers in various cultivable waters at a cost of Rs. 37 lakhs, out of which 50% cost of seed is met as subsidy. It is anticipated that this programme will give an additional fish

Table 1: Status of fish production (t) : 2000-01

Category (lakhs t)	*Production*	*Rank*	*Competitive states*
1. Marine fish and shrimp production	1.82	Fifth	Gujarat, Kerala, Maharastra, Tamilnadu
2. Inland fish and FW Prawn production	4.07	Second	West Bengal
3. Brackishwater shrimp production	0.38	First	West Bengal (0.21) (lakh t) in second position

Table 2 : Share of A.P. in Indian Fish production in India : 2000-01

Name of the Item (lakh t)	*India*	*A.P.*	*% A.P./India*
1. Marine fish and shrimp production	28.10	1.82	6.48%
2. Inland fish and prawn production	28.14	4.07	14.31%
3. Brackishwater shrimp production	0.97	0.53	48.97%

oduction of 6,500 tonnes valued Rs. 00 lakhs.

Exports: The value of marine prodt exports from the State reached a sigficantly high level of Rs. 2400 crores, hich is nearly 40% of the total national arine product exports of Rs. 6400 ores during 2000-01.

Contributution to GSDP: The fisherss sector is contributing to 2.31% of ross State Domestic Product (GSDP).

Scampi Production: The State has ade a remarkable progress in Freshater prawn (Scampi) production by creasing the area under culture from .11 lakh ha. in 1999-2000 to over 0.20 kh ha in 2000-01. This increase is ea is because of efforts by farmers to iversify from shrimp culture, as culured shrimps are affected by WSD White Spot Disease). The Department f Fisheries has taken the initiative of romoting scampi culture by supplying eed, and arranging demonstration of the ulture in tanks and ponds. The efforts re being continued with focus on tanks nd ponds in upland areas.

e) Shore to vessel communication: Strengthening of the Shore to Vessel ommunication system has been done hrough establishment of 12 nos. of shore ommunication stations along the entire oastline of 974 km and supplying more han 550 nos of VHF sets to the sea gong fishermen. This effort is supplemented by disseminating round-the-lock two-way communication on veather warnings, availability of fish in lifferent fishing grounds etc. This had he positive affect of minimising the loss f life and boats.

f) Gambusia fish production: The department has made inroads into public ealth sector by taking upon itself the roduction and supply of Gambusia fish n tackling and controlling the mosquito menace and thereby containing pread of malaria and JE disease in the tate. The Department of Fisheries has roduced 69.06 lakhs of the fish surassing the target. It is quite heartening to observe that the no. of JE cases as come down from 203 to 72 and further down to mere 4 nos. in 2001. Similarly the no. of malaria cases have also come down.

g) Establishment of Common facility Centres: The Department has developed the design of common facility centres with all basic facilities like office room, storage for nets, cyclone shelter, space for drying of fish etc. Nine such centres have been constructed at a cost of Rs. 10 lakhs each. The National Coop. Development Corporation which has funded the scheme is quite satisfied with the components of the centres and are ready to include them in the next phase of the project.

h) Construction of fishing harbour at Machilipatnam: The State Government has sanctioned the establishment of a fishing harbour at Machilipatnam at a cost of Rs 6.4 crores. The harbour works have started in November, 1999. Half of the construction work has been completed and further work is in progress. The harbour, when completed, will provide berthing facilities to 350 mechanised fishing vessels and because of the facility the fish production is expected to increase from 3,000 t to 9,000 t valued at Rs. 27.00 crores.

i)Supply of FRP motorised fishing crafts under NCDC - assisted scheme: The Integrated Marine Fisheries Project Phase II is under implementation with an outlay of Rs. 21.65 crores. 373.31 lakhs have been released in 2001-02 and 156 nos of FRP motorised fishing crafts with nets, 41 mopeds with ice boxes, 894 nos. of cycles with thermocole boxes were supplied. The Phase III of the project to extend the benefit to all coastal districts was sanctioned by the National Coop. Development Corporation with an outlay of Rs. 27.86 crores.

j) Enhancement of ex-gratia under Group Accident Insurance Scheme: The ex-gratia payment under this Scheme for fishermen has been enhanced from Rs. 35,000/- to Rs. 50,000/- in case of death/ total disablity and Rs. 17,000/- to Rs. 25,000/- in case of partial disability.

K) Relief Cum Saving Scheme: The scheme is extended to both marine and inland fishermen. Under the revised pattern the marine fishermen have to save Rs. 600/- (Rs. 75 X 8 months) and the assistance provided is Rs. 600/- shared by State and Central Governments. The assistance provided is Rs. 450/- in the case of inland fishermen, which is equal to the amount saved by each one of them (Rs. 50 X 9 months).

l) Enhancing of unit cost of housing for fishermen: The unit cost of each of the houses for fishermen has been enhanced from Rs. 20,000/- to Rs. 40,000/-. Sanction has been accorded for constructing 2929 houses this year.

Future Plans

The future plans are drawn up by setting up of the targets till the year 2010. The target proposed for production of fish/prawn/shrimp are given Table 3.

For achieving the above targets, the department has drawn up detailed action plans for development of fisheries in all three sectors (i.e.,marine, inland, brackishwater), besides schemes towards the improvement of socio economic status of the stakeholders.

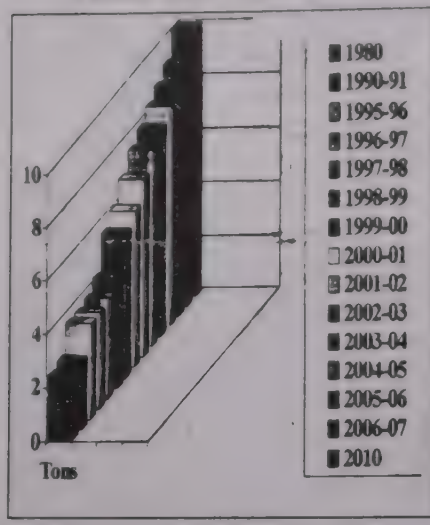
Future plans in Development of Fisheries

Marine Fisheries: The important schemes proposed to be taken up for improving fish production by augmenting fishing effort and by minimising the losses with details of physical and financial details are given below:

Table 3 : Future Production Targets Lakhs/t

S. No.	Source of	01-02	02-03	03-04	04-05	06-07	07-08	2010
1.	Marine fish	1.95	2.10	2.20	2.30	2.40	2.50	2.75
2.	Inland fish	4.05	4.50	4.70	4.90	5.10	5.40	6.00
3.	Marine shrimp	0.25	0.30	0.30	0.35	0.40	0.40	0.50
4.	F.W.Prawn	0.45	0.50	0.60	0.65	0.70	0.70	0.75
	Total	6.70	7.40	7.80	8.20	8.60	9.00	10.00

Target of fish production for next 5 years
Vision 2020 Goal: 10 lakh tons of fish production



YEAR	INDIA	A.P.
1997-98	53.88	3.73
1998-99	52.62	4.11
99-2000	56.57	5.46
2000-01	56.55	5.89
2001-02		6.70
2002-03		7.40
2003-04		7.80
2004-05		8.20
2005-06		8.60
2006-07		9.00
2010		10.00*

• Estimated potential : 12 lakh tonnes

• Vision target of 10.00 lakh tons will be achieved by 2010 itself as per the Action Plan

i) Popularising of improved designs and supply of FRP craft and tackle: The Integrated Marine Fisheries Project sanctioned by NCDC for implementation in the nine coastal districts has already come up in six of them and is nearing completion in the remaining three districts. Because of the Project, marine fishermen in 6 coastal districts are benefited. 950 nos. of FRP crafts will be supplied in all the districts in 3 years. 90% of the cost of input is being given by NCDC as financial assistance to the project.

ii) Progressive motorisation of traditional crafts: The fishermen will be able to venture out for fishing in deeper fishing grounds, save energy in rowing the crafts and return to markers in time, when they are provided with suitable vessels. Under NCDC assisted scheme, 90% of the assistance in this regard is being provided. Under Centrally Sponsored Scheme, a subsidy of Rs. 10,000/- to Rs. 12,000/- is being given by the Government to fishermen towards the cost of Outboard/Inboard motors.

iii) Operation of Patrol Boats: To enforce the provisions of MFR Act, the patrol boats provided by Govt of India will be operated. Funds are required for fuel and for the police staff to be employed on these boats and these are in the process of being provided.

iv) Shore to Vessel Communication system: 12 nos. of shore communication stations have been established and are functioning round the clock providing two-way communications to fishermen on weather conditions and also on potential Fishing zones (PFZ) in the sea. The equipment is run on batteries and maintained by charging the batteries, maintenance of tower etc. The system is unique and has received appreciation of the fishermen and it is also being followed by other States.

v) Supply of VHF sets: The fishermen are being giving VHF sets on 50% subsidy basis by utilising the funds received from VRF Trust. The cost is about Rs. 13, 000/- each.

vi) Cage culture of Groupers and Snappers : The Minister for Fisheries and Commissioner of Fisheries, A.P. have undertaken a study tour to Thailand and Malaysia recently. It was observed that, apart from the usual land-based aquaculture, Cage culture out at sea is being practised and it is noted that this will not affect the environment. The Network of Aquaculture Centres in Asia-pacific (NACA) has agreed to provide assistance for setting up sea cages.

vii) Completion of Machilipatnam Fishing harbour: The construction of Machilipatnam fishing harbour has been taken up at a cost of Rs. 6.4 crores. This harbour will provide berthing facilities to 350 boats after its completion. The harbour is anticipated to be put in to operation by August, 2002.

viii) Construction of Mini-fishing harbours and landings facilities at water front: The Central Institute of Coastal engineering for Fishery (GOI) and State Department of Fisheries have identified suitable places to take up construction of four mini habours and 2 landing centres. Andhra Pardesh is the only State which could not provide such facilities so far and this has resulted in loss of fish catches. This scheme is expected to remove the lacuna.

ix) Dissemination of satellite technology for identification of Potential Fishing Zones: INCOIS, a GOI organization is sending the information collected from satellites, twice in a week, about the potential fishing zones in the sea (PFZ) and a comprehensive programme of displaying the information at all important places for easy understanding of the fishermen and to enable them to derive benefit out of this new technology has been taken up. Already 19 centres are covered and the programme is being extended to 50 centres.

x) Tuna Fishery Project: An international agency, World Tuna Development Inc, has come forward to pass on the technology of exploitation of tuna fish which has export value. The state government have to invest Rs. 9 crore against the total project cost of Rs. 6 crores. It is planned to implement this within two years.

xi) AEZ: It is also envisaged to create Agri Export Zone in the 9 Coastal Districts of Andhra Pradesh to facilitate easy export of fishery products by the industry.

Marine Fisheries ~ Action Plan for next 5 years: An action plan for the development of marine fisheries of the state has been drawn up. The particulars are as follows.

Inland Fisheries

The inland fisheries resources potential is not yet fully exploited. Yet the State is in an advantageous position of being in the fore front in freshwater scampi production and second in inland fish production among the various States. Already the fish produced in the State is being supplied to most of the North-eastern states and other neighbouring countries. The ornamental fish culture and fresh water pearl culture are thrust areas identified for the

ming years. The following ogrammes have been now taken up.

versification into culture of alternate ecies – Fresh water prawn (scampi) rming The water area under freshter prawn farming in the State has creased from 0.11 lakh ha in 1999-00 to 0.21 lakh ha in 2001-2002. bout 7,000 tonnes of scampi were exrted from the State against 7,500 nnes exported from the country in 00-01. A subsidy at Rs. 30,000/ha is oposed to encourage farmers to take scampi culture. Thrust is being imrted to popularise culture of this spees in upland areas of Telangana and Rayalaseema regions by encouraging stocking of this species in perennial and long seasonal tanks of the regions.

New approaches in seed stocking: Hitherto the seed in fry stage is being stocked in tanks, ponds etc. Because of this, mortality is taking place due to predation etc. In order to avoid this loss, stocking with fingerlings in advanced growth stages is now being encouraged for achieving a good rate of survival and growth. It is also proposed to provide subsidy on cost of fish seed produced by the farmers.

Integrated Fisheries project in Warangal district: The National Coop Development Corporation has sanctioned the Integrated Inland Fisheries project in Warangal district at a cost of Rs. 1.32 crores for the production and supply of fish seed, supply of coracles and thermocole teppas, supply of ice boxes etc.

Reservoir Fisheries Development Project: The rate of fish production in reservoirs, specially in major reservoirs is very low. There are seven major reservoirs which are proposed to be developed by stocking with advanced major carp fingerlings.

Establishment of modern fish marketing complexes: The major concern is unhygienic handling of fish, inadequate preservation facilities etc., which are adversely affecting the consumer acceptance. It is proposed to establish modern fish marketing complexes with facilities to handle wholesale and retail fish marketing, supported by a display system of rates of different varieties of fish and others. 50 such centres are proposed to be set up to upgrade the handling of fish and to achieve consumer acceptance of fish. Canteens are also proposed to be set up as part of the markets.

Establishment of subsidised Ice plants and Cold storages in private sector: It is very important to preserve the fish soon after they are caught to maintain quality. Entrepreneurs will be encouraged to set up ice plants and cold storages by providing subsidies, wherever required.

Table 4 : Marine Fisheries - Action Plan for Next 5 Years

Item	*Nos.*	*Years*				
.Cost (Rs. in lakhs)	Cost	02-03	03-04	04-05	05-06	06-07
Supply of FRP crafts (NCDC) assisted IMFP phase III	Nos.	200	450	300		
	Cost	360.00	780.00	520.00		
2.Motorisation of Trad. crafts (subsidy and supplied under NCDC scheme-IMFP phase III)	Nos.	380	370	200	200	200
	Cost (Rs/lakhs)	126.00	119.00	20.00	20.00	20.00
3.operation of Patrol boats	Nos.			2		
	Cost (Rs/lakhs)	70.00	75.00	80.00	85.00	90.00
4.Maint. of shorecommunication S tn.a	Nos.			12		
	Cost (Rs/lakhs)	5.00	12.00	12.00	12.00	12.00
5.Supply of VHF sets (with VRF trust board funds) on 50% subsidy basis	Nos.	100	100	150	150	200
	Cost (Rs/lakhs)	6.00	6.00	9.00	9.00	12.00
6.Cage culture of Groupers, Snappers etc.	Nos.			3		
	Cost (Rs/lakhs)	50.00	10.00	11.00	12.00	13.00
Completion of Machilipatnam fishing harbour	Cost (Rs/lakhs)	178.00	220.00			
7.Taking up construction if mini harbours	Nos.	1	1	1	1	
	Cost (Rs/lakhs)	200.00	220.00	240.00	260.00	
8.Taking up construction of landing	Nos.	5	5	5	5	
	Cost (Rs/lakhs)	150.00	160.00	170.00	180.00	
9.Dissemination of using satellite technology for identification of potential fishing zones in the sea	Nos.			50		
	Cost (Rs/lakhs)	10.00	11.00	12.00	13.00	14.00
10.Introduction of vessels for Tuna fish exploitation	Nos.	6	2			12
	Cost (Rs/lakhs)	675.00	225.00			

Utilisation of shrimp hatcheries to produce juveniles of scampi: There are more than 130 nos of shrimp hatcheries operating but these are not working to their full capacity. At present the number of scampi hatcheries are around 20, including some of the shrimp hatcheries which have been converted to produce scampi juveniles. The other shrimp hatcheries will be encouraged to take up production of scampi juveniles by providing subsidies.

Encouraging farmers to take up Ornamental fish and Freshwater Pearl culture: Some of the States like West Bengal, Maharashtra, Tamilnadu and Karnataka have established aquaria and also have been encouraging ornamental fish culture and the results are stated to be quite encouraging. Exports of ornamental fishes from these States are picking up as the technology of freshwater pearl production is available in the country. As in China, Japan and other countries, there is good scope for promoting this activity in the private sector. Pearls in the shapes of divine incarnations can also be produced. Because of the export potential, these new technologies will be encouraged by providing subsidies in the State for adoption in the private sector.

Brackishwater Fisheries

Andhra pradesh is in an advantageous position in respect of coastal aquaculture production. More than 0.70 lakh ha. of area has been developed in the State for shrimp culture. The Tiger shrimp, the pride of our exports is now being cultured in frehswater bodies also. Due to unregulated activity, there have been problems like spread of White Spot Disease (WSD) and farmers are losing shrimp crops of considerable value because of this dreaded disease.

The government have taken many steps for sustainable coastal aquaculture including steps for introduction of alternate species of culture, and establishment of disease diagnostic laboratories etc.

Integrated Coastal Aquaculture: Under the centrally sponsored scheme, it is proposed to encourage farmers by providing subsidies to them to take up traditional and improved traditional methods of shrimp farming linking the same with a training programme. Farmers will be encouraged to take up culture of alternate species like Scampi, seabass fattening of mud crab. etc.,

Organisation of Aquaclubs: 126 Aqua clubs have been organised with 3,321 members for adopting collective approach in shrimp farming for effective control of diseases etc. It is proposed to organise 130 such Aqua clubs in the next five years. The concept behind the organisation of Aqua clubs is to inculcate the spirit of co-operative approach in management practices, tackling disease problems, ensuring quality of the feed and other allied aspects related to sustainable culture practices etc.

Establishment of Stationary/ mobile disease diagnostic and microbiological laboratories: Now there are 11 laboratories with PCR facilities, five in public sector and six in private sector. The assistance from FAO is also anticipated for the establishment of more number of well equipped laboratories for disease detection. It is essential to have mobile laboratories in the State sector and within the easy reach of the farmers. The R & D work on the subject of disease control is a thrust area for further development.

Establishment of Effluent Treatment plants: The Aquaculture Authority has suggested the addition of Effluent Treatment Plants for farms of 5 ha and above. Accordingly, it is proposed to encourage farmers to set up such plants, with provision of subsidies.

Establishment of Artemia processing plant: Artemia cysts are the source of live feed essential for the health and growth of shrimp larvae. These are now being im

Table 5 : Inland Fisheries ~ Action plan for next 5 years

Item	*Nos.*	*Year*				
Cost Rs. in lakhs	Cost	02-03	03-04	04-05	05-06	06-07
Diversification to alternate species-	Ha	1000	1000	1000	1000	1000
Encouraging F.W. prawn culture (as per MPEDA subsidy rates)	cost	300.00	310.00	320.00	330.00	340.0
New approaches in stocking of	Seed lakhs	260	500	500	500	500
fish seed-subsidy.	cost	37.00	75.00	75.00	75.00	75.00
Integrated project for inland	Seed lakhs	39	39			
fisheries -Warangal:seed stocking	cost	11.70	11.70			
Integrated project for Inland Fisheries		317	300			
-Warangal: coracles Theppas & others		48.47	54.39	5.91		
Reservoir fisheries development	Nos.		5	5	5	5
	cost		10.00	12.00	14.00	16.00
Establishment of modern fish	Nos.	10	10	10	10	10
market complexes	cost	400.00	410.00	420.00	430.00	440.0
Establishment of Ice plants and Cold	Nos.	5	5	5	5	5
storages-subsidy	cost	10.00	11.00	12.00	13.00	14.00
Utilisation of B.W shrimp Hatcheries	Nos.	10	10	10		
to produce FW prawn Juveniles	cost	8.00	8.00	8.00		
subsidy @ Rs. 80,000 -						
Encouraging farmers to take up culture	Nos.	5	5	5	5	5
or ornamental fishes @ Rs. 21 lakhs	cost	10.00	11.00	12.00	13.00	14.00
exporters as per MPEDA subsidy						

rted at high cost and on paying im-
rt duty. With the result, the farmer is
rced to use alternative and cheaper feed
hich is resulting in high susceptibility
shrimp to White spot syndrome. M/s
IVE Co., Thailand who are the lead-
s in the production of Artemia cysts
ive agreed to establish an Artemia pro-
ssing plant in Andhra Pradesh which
being followed up.

***ommon approaches towards im-
rovement of socio economic status
f fishermen*:** The common approaches
or improvement of socio economic sta-
is of fisher populations and for sustain-
ble growth of the sector include con-
nuance of the existing welfare schemes
nd also the following schemes:

) Village access roads: There are 508
narine fishing villages all along the
oastline of 974 km of the State. and
lans are being drawn for laying access
oads linking the potential fishing vil-
ages from main roadheads.

ii) Supply of Tri-wheelers and Mopeds to fishermen: The supply of mopeds and tri-wheelers with ice boxes will be very useful for the small fishermen for quick transport of their catches to nearby markets. It is accordingly proposed to continue the scheme for supplying these.

It is also proposed to have information kiosks to disseminate information on prices of fish and shrimp. Information of satellite based Potential Fishing Zones to the fishermen will also be disseminated through such booths.

iii) Construction of Pucca houses for fishermen: The fishermen will be provided with pucca houses and also common amenities like community halls, tube wells etc., under the centrally sponsored scheme. The unit cost for housing is Rs. 40,000/-. It is proposed that every year 200 houses will be taken up for construction.

iv) Assistance to fisherwomen: The fisherwomen are borrowing amounts to meet working capital requirement for fish marketing business at an exorbitant rate of interest. It is proposed to provide working capital assistance at Rs. 1000/each and the same will be used as revolving fund by the society concerned to provide fresh loans to other members of the society.

v) Ornamental fish culture and establishing Aquaria: Ornamental fish culture and glass aquaria to keep the fish are gaining lot of importance and thrust in recent times. This activity is not only providing employment to unemployed youth but has also good potentiality to promote export market. The establishment of aquaria will help to attract tourists and in this direction the States of Tamilnadu, Karnataka and Maharashtra have done considerable work. Some of the departmental officers have also been sent for training in this regard. The aquaria dealers have been organised into an association. The Marine Products Export Development Authority is also lending support to the farmers engaged in ornamental fish breeding, their culture and export. So, plans are being formulated for establishing aquaria at all tourist places in the State. It is hoped that this scheme will generate interest in breeding of aquarium fishes amongst youth so that they can resort to this avocation as means of better productive employment.

vi) Freshwater Pearl Culture: The Central Institute of Freshwater Aquaculture has developed the technology of producing pearls from freshwater mussels. The technology is simple and the product has good market. The State Institute of Fishery technology, Kakinada. is conducting training programmes with practical orientation on this subject for the benefit of the aqua farmers. The farmers have evinced interest and have taken up culture of pearls shaped in the form of divine incarnations. This is achieved by insertion of nucleus in incornation shapes in to the animal. It is believed that these unique pearls will attract good market demand.

vii) Introduction of Cage culture and establishment of Artemia processing plant: The Minister for Fisheries and Commissioner of Fisheries, A.P. have undertaken a study tour to Thailand and Malaysia and follow up action has already been taken up on the introduction of the following best practices being adapted in these countries.

a) Cage culture as a diversification method. Taking up training programmes in this regard with assistance from NACA, Thailand:

b) Collaboration with

Table 6 : Brackishwater Shrimp Farming ~ Action plan for next 5 years

Item	*Nos.*	*Year*				
Cost Rs. in lakhs	Cost	02-03	03-04	04-05	05-06	06-07
Integrated coastal aquaculture	Ha	12	60	60	60	60
development subsidies to farmers	Cost	4.00	20.00	22.00	25.00	30.00
Organisation of Aqua clubs	Nos.	20	20	25	30	35
Establishment of disease diagnostic	Nos.	3	4	3		
laboratories	cost	75.00	110.00	85.00		
Establishment of Mobile labs	Nos.	3	4	3		
	cost	60.00	85.00	65.00		
Microbiological labs & Quality	Nos.	1	1	1		
control labs	cost	30.00	32.00	35.00		
Effluent treatment plants (subsidy	Nos.	300	300	300	300	300
@ 7.00 lakhs each as per MPEDA)	cost	210.00	220.00	230.00	240.00	250.0
Artemia processing plants providing	Nos.	1				
subsidy.	cost	10.00	15.00			

Table 7 : Common approaches ~ Action plan for next 5 years

Item	*Nos.*	*Year*				
Cost Rs. in lakhs	Cost	02-03	03-04	04-05	05-06	06-07
Village access roads	Km	100	120	200	200	50
	cost	450.00	540.00	920.00	950.00	300.0
Insulated Transport vans-subsidy.	Nos.		1			
	Cost		8.00			
Supply of mopeds and three wheelers (NCDC scheme)	Nos.	115	230	100		
	cost	35.00	70.00	20.00		
Processing plants with packing (subsidy @ Rs. 7.5 lakhs as per MPEDA subsidies)	Nos.	2	2	1		
	cost	15.00	16.00	8.00		
Market information kiosks (Subsidy @ Rs. 40,000)	Nos.	100	200	200		
	cost	40.00	41.00	42.00		
Subsidy of Ice boxes (NCDC & MFPI scheme	Nos.	3030	1175	475		
	cost	83.00	47.00	19.00		

M/s Golden Hope co., Malaysia for sustainable brackishwater aquaculture; and

c) Establishment of Artemia Processing Unit (live feed for shrimp larvae) involving M/s INVE co., Thailand.

viii) Exploitation of Tuna fishery : The negotiations with M/s World Tuna Development Inc are in the advanced stage for exploition of Tuna fisheries of Indian EEZ. The Tuna fish is an underexploited marine fish which has good export market. This project to be taken up will have an outlay of Rs. 68 crores.

Attempts are being mad to implement this proje in order to increase th exports from the Sta as well as generatin employment in rural a eas through setting u of processing plants, an related ancillary indus tries.

Lastly, it is envisage to utilise the immens scope that exists fo development of fisherie in the State throug rational utilisation o available fisheries re sources, their regulated tapping in a sus tainable way, and involvement of th stokeholders in the endeavour in a re sponsible way. Responsible fisheries wi be the main theme/ focus for achievin the targets set by the Department for th proactive holistic development of fish eries of the State.

Travails with Tiger Shrimp

Mr. Brett L Koonse, Chief Programmer, of US FDA who was on a visit to shrimp production centres in A.P. has explained to the producers and processors the problems US faces in importing tiger shrimp. According to him shrimp is found to be a potential carrier of *Salmonella*, a human health hazard. When 300 persons in USA became ill after consuming tiger shrimp imported from six countries including India, US authorities were alarmed, he said.

Speaking at a meeting at Bhimavaram, A.P., on 'Good Aquaculture Practices' on 25 April organised by MPEDA, he said that contamination of feeder channels to shrimp ponds, defecation by animals and human beings and droppings by rats and birds, happened to be the carriers of harmful bacteria such as *Salmonella* which was found in 8-10% of aquaculture products. He emphasised the need to bring this down to zero level. He also called for remedial measures by checking the misuse of feeder channel waters for use after defecation. It was mentioned by him that FDA had formulated a strict policy to check import of shrimp products with heavy bacterial load.

Radar Observer (Fishing) Certificate Course

The Central Institute of Fisheries Nautical & Engineering Training Unit, 59, S.N. Chetty Street, Chennai - 600 013 Tel: 5952691/92 will be conducting courses on the captioned subject.

The course will be of 15 days duration. The course would consist of theoretical and practical sessions at the institute for the benefit of candidates appearing for Mate of Fishing Vessels/Skipper Gr II/ Gr I. Competency Certificate Examination in accordance with the requirements of M.S (Examination of Skipper & Mates of Fishing Vessels) Rules 1987.

The venue of the course is CIFNET, 59, S.N. Chetty, Royapuram, Chennai - 600 013. The course fee is Rs.500/- only. The examination fee is Rs.150/- and the Caution deposit is Rs.1000/- (Refundable).

Candidates who have successfully completed MFVC at CIFNET or thos who have put in minimum 12 month qualifying sea service are eligible to un dergo the couse.

Candidates seeking admission ma apply along with the Bio-Data (form ca be obtained from the Deputy Directo CIFNET, 59, S.N. Chetty Stree Royapuram, Chennai - 600 013) and re serve the seat with advance payment o Rs.250/- which will be adjusted wit course fee at the time of admission. Th payment may be made in the form o D.D. drawn in the favour of Deputy D rector, CIFNET, Chennai - 13 take from any nationalised bank.

Candidates will be provided board ing and lodging on optional basis a Rs.300/-, for Hostel Accommodation fo 2 weeks duration and food in the hoste on payment of Rs.12/- for lunch an Rs.10/- each for breakfast and dinner.

The programme will be conducte for the duration of 15 days in thre batches. XV batch will be commence on 03/06/2002, XVI batch will be com menced on 09/09/2002 and XVII batc will be commenced on 09/12/2002.

Status of Fisheries Development in Bihar and Future Plans

R.N. Chaudhury
Director of Fisheries

Manoj Kumar
Deputy Director of Fisheries

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After creation of Jharkhand State, ihar has lost a sizeable extent of water reas in the form of reservoirs as well as onds. Almost 70% of large reservoirs re now in the new State of Jharkhand. As far as fisheries resources in the State of Bihar are concerned, they mainly comprise ponds, tanks, small reservoirs, ivers and water-logged areas like ox-ow lakes and *chaurs*. Around 65,000 a. of water areas are covered by ponds and tanks and nearly 35,000 ha. of wa-er areas consist of *chaurs* and ox-bow lakes.

Geographical and Fisheries Scenario of the State

Bihar is a completely land-locked State. The State is virtually divided by the river Ganges into two distinct parts, north and south Central Bihar. According to 2001 census the total population of the State stood at 82.87 million. Density of population is 880 persons per sq.km. The percentage of decadal growth rate of population has been estimated at 28.43. Thus, population explosion has increased demand for food grains as well as fish and fish products. The average annual rain fall of the State has been 1,247.29 mm and major rivers flowing through the State are the mighty Ganges, Gandak, Kosi, Bagmati, Mahananda, Sone and Punpun. The number of administrative districts of the State are 34 with 45,337 villages and the number of functional FFDAs in the State are 33. About 50 to 60% of people in the State consume fish and average annual demand for fish in the residual State of Bihar is 4.5 lakh mt. At present average annual production of fish in the State is 2.2 to 2.5 lakh mt. and average annual production of fish seed is 350 million nos, whereas net demand of fish seed in the State is nearly 600 million fry per year. There are 18 hatcheries in the State; one in Govt. sector, three in corporate sector and 14 in private sector.

Major Constraints in the Development of Aquaculture in the State

These are identified as follows: 1) Over 40% of tanks and ponds are not suitable for fish culture due to siltation and infestation with macrophytes; 2) Inadequate production of quality fry and fingerlings; 3) Unscientific utilisation of reservoirs for fish production; 4) Lack of proper extension-training system; and above all, 5) Lack of entrerpreneurship in fisheries sector.

Plans and Future Prospects

Fisheries sector has vast potential to provide employment to the people in rural areas and to improve the socio-economic conditions of rural as well as urban entrepreneurship. Considering this situation, the fisheries development in Bihar is considered as one of the high priority areas. There is abundant scope for horizontal and vertical expansion of aquaculture in the State. In a nut-shell the main physical objectives in this context to be achieved are:

(a) Bringing riverine wetlands into fish culture system; (b) Infrastructural strengthening of training-extension system; (c) Quantitative and qualitative increase in fish and fish seed production; (d) Development of old derelict water bodies, and (e) Socio-economic change in the life of fishermen community.

The main schemes being implemented by the department are: (i) Fish Farmers Development Agency scheme; (ii) Production and supply of quality fish seed; (iii) Development of reservoirs fisheries; (iv) Ox-bow lakes and *chaur* Development scheme; (v) Training-Extension scheme; (vi) Group accident Insurance scheme; (vii) Housing for fishermen, and (viii)Fisheries Research Scheme.

Government of India has sanctioned schemes for fisheries development in water logged areas and development of reservoir fisheries of the State as Central sector schemes. The Draft Annual Plan for the year 2002-2003 has been fixed at Rs. 245 lakhs. The plan envisages development of atleast 100 ha. of riverine wetland annually for fish production.

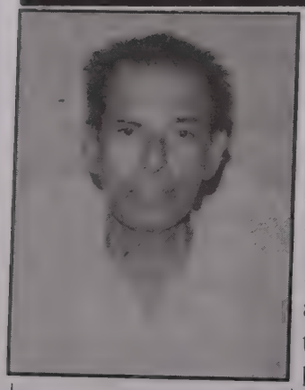
During Tenth Five Year Plan (2002-'07), additional 5,000 ha. of water area is proposed to be developed and brought under culture pattern of periodic cropping. It is proposed to construct 1,200 houses for fisher families and to impart training to additional 5,000 fish farmers. The total number of insured fishermen is proposed to be increased to 50,000 from the current level of 40,000. The overall productivity level of developed ponds is envisaged to be brought upto 3,000 kg/ha./year from the current level of 2,175 kg/ha./year.

Mathew Abraham is the New Director of CIBA, Chennai

Dr. Mathew Abraham has taken charge as Director, Central Institute of Brackishwater Aquaculture, Chennai, in the place of Dr. G.R.M. Rao, who has retired from service on superannuation at the end of March 2002. It was during his Directorship, the work related to sea bass hatchery seed production has been standardised and transfer of the hatchery technology has been taken up.

Status of Fisheries Development in Tripura

S.K. Sarkar
Director of Fisheries, Government of Tripura
Agartala,- 799 001, Tripura



S.K. Sarkar

Fish is an important item of food to almost all the people (about 95%) of Tripura. Freshwater aquaculture in the country has emerged as one of the most economic farming activity. In spite of impressive performance of fisheries sector, in Tripura of a wide gap continues to exist between demand for fish and its availability. The growth rate of production of fish could not keep pace with the rate of increase of population. The production of fish has increased from 181 mt (end of 1st plan) to 29,000 mt (end of 9th plan), whereas the demand for fish has increased from 4,800 mt (end of 1st plan) to 33,000 mt (end of 9th plan) in the State. The present annual deficit in fish production of the State is 4000 mt.

In this scenario, aquaculture has to play a great role in reducing the wide gap between requirement and present level of production of fish. In this context promotional work is being carried out on modern scientific lines with the available limited aqua resources of the State. Development of culture fisheries, besides adding to the present fish production, will also create job opportunities for a very large section of the population when the work is taken up on a large scale.

Departmental Activities for Development of FIsheries in Tripura

Tripura is a hilly land-locked State which solely depends on inland fisheries for fish production. In the last few decades the Department of Fisheries has initiated and promoted many developmental activities in fisheries sector. Some of these are furnished hereunder.

Increase in Culture Production Area

The Primary requisite for aquaculture is suitable water bodies. In Tripura, rivers, streams and rivulets are perennial due to hilly terrain and 60% of total land mass is covered by forests. The aqua resources in the State have increased from 6,705 ha (end of 1st plan) to 23,342 ha (end of 9th plan) which is only 2.22% of the total geographical area of the State. The State has reached almost the saturation stage in horizontal expansion of culture water area.

Major breakthrough in horizontal expansion happened in fisheries sector with the establishment of Fish Farmer Development Agencies (District-wise) and conversion of *lunga* land into "Minibarrages" in hilly area. So far 4,270 ha of water areas has been developed under minibarrages through mandays generation programme and 3,173 ha of ponds/tanks are constructed through FFDAs under subsidy-based credit linked programme.

Production of Fish

The present average fish production from culture fishery in the State is 2,100 kg/ha/yr which needs to be increased up to the tune of 3,000 kg/ha/yr to overcome the deficit as well as to make the State self sufficient in fish production.

Carps constitute the main fish that is cultured in the State. The different fish culture systems that have been adopted in the State through a continuous demonstration programme are as follows: i) Composite Fish Culture; ii) Integrated Fish Culture with birds/pigs; and iii) Semi Intensive Fish Culture.

The State solely depends on accumulated rain water in ponds for aquaculture. It has no scope for intensive aquaculture of fish, with water exchange facilities.

Production of Fish Seed

Aquaculture development largely depends on the use of quality fish seed. Importance is given to production of fish seed so as to utilise all available culture water resources for fish production. The State has already gained a surplus status in fish seed production due to transfer of fish breeding technology in simple form to rural fish seed growers. The total production of fish seed (fry) has increased form 8.4 million (end of 1st plan) to 210 million (end of 9th plan) due to establishment of Eco-hatcheries (Chinese model) both in Government and private sectors.

Establishment of Giant Fresh Water Prawn hatchery

During 1999-2000, the Department established a mini prawn hatchery unit, to produce post larvae of giant freshwater prawn, *Macrobrachium rosenbergii* (known in Tripura as *Galda chingri*) at Agartala where production of prawn PLs has already started. 2-3 more prawn hatcheries are being constructed in other district of the State. The objective of setting up the hatcheries is primarily to demonstrate the hatchery technology to farmers and to introduce them to take up polyculture of this prawn with major carps. The needed seed supplies will be made from these hatcheries. The tech-

logy of polyculture of freshwater rawn with major carps is being adopted the farmers. The adoption of prawn ulture in the State is expected to change e economic scenario of the State and e fisheries department is also optimis- in respect of supply of prawn juve- iles (pure variety) to the neighbouring orth-Eastern States after meeting in- rnal requirements.

Extension and Training Programme

The fisheries extension network is unctioning in the State up to grass root evel (panchayat Level). In order to notivate the fish farmers for adopting cientific cultural practices, demonstra- ion programmes are regularly under- aken.

With a view to providing sufficient echnical support to the fish farmers, egular training programmes/group dis- ussions/seminars at various level are be- ng conducted in the State. The Depart- ment has already constructed permanent State/District level Fisheries Training centres for imparting training to both the grass root level staff as well as fish farm- ers. FFDAs are also involved in con- ducting training programmes.

Welfare Programmes

Poor fisher families are helped by way of providing houses and potable water supply under the Central sector scheme "Welfare for Fishermen Fami- lies" (CSS 50:50). So far 1063 fami- lies have been covered under this scheme.

Fishermen Group Accident Insur- ance benefit is also provided to all members of Fishermen Co-operative So- cieties (10,000 nos.) of the State every year.

Financial support in the form of Share capital and Managerial subsidy is also provided to primary and Apex Fish- ery Co-operative Societies as and when required.

Cast/drag nets, boats etc. are supplied for fishing in open bodies to the poor fishermen through utilisation of Panchayat fund.

.... Towards self-sufficiency in fish production by 2012

The main thrust of the Department would be in the culture production of major carps, besides development of sub- sidiary fisheries, other than major carp culture. In this context fish culturists and those in the co-operative sector are encouraged through massive awarness, motivation and training programmes to increase present level of fish production by adopting the latest available scien- tific fish cultural techniques. A cam- paign is also being launched to ensure that no water body is left fallow in the State.

With a view to reaching the goal set for raising production a co- ordinated approach among the con- cerned Departments , FFDA, Panchayat bodies and Financial Institutions is being promoted. The Department is poised to make all efforts to increase the production of fish by 45% within next ten years so as to meet esti- mated demand of fish, while leaving a surplus too. The production targeted is 38,970 mt by 2012.

In this background, the Department of Fisheries has prepared a ten year Per- spective Plan (2002-12) to attain self sufficiency in fish production adopting the following strategies:

i) Creation of additional 600 ha of new water bodies within the limited scope in phases by converting non- agricutlural marshy/fallow wetlands into fish ponds:

ii) Reclamation of 4600 ha old aqua bodies in a phased manner to achieve production upto desired level:

iii) Introduction of improved variety of carp seed for rapid growth and di- versification of aquaculture:

iv) Involvement of Fishermen Co-op- erative Socities for achieving higher production of fish :

v) Efficient extension and training sup- port to cover all fish farmers (93,870 nos.) in the State :

vi) Adopting local research on improved practices for enhancing aquaculture production; and

vii) Awarding of prizes to progressive fish farmers for optimising produc- tion of fish year to year in a progres- sive manner and also to base level technical staff for their best perfor- mance.

viii) The Department will explore all possibilities to get maximum finan- cial assistance from Central Govern- ment.

Salient Features of Perspective Plan

1. The average productivity of fish from culture fishery resources will be raised from the present level of 2,100 kg/ha/yr to 3,000 kg/ha/yr by the end of 2011-2012.
2. Culturable water resources potential will be raised from the present 13,342 ha to 13,955 ha by the end of 2011-2012.
3. Total financial involvement will be of the order of Rs.9990 lakhs.
4. Cumulative value of additional pro- duction of fish and prawn etc., is envisaged at Rs.37,362.95 lakhs.
5. A cumulative total of 1,10,053 fami- lies will be benefited through vari- ous fisheries projects during the pe- riod 2002-12.
6. Self opportunities of employment will be created for 15,187 persons for 53.89 lakhs man days.
7. The target of fish production by the end of 2011-2012 has been fixed at 42,210 mt in the State, and
8. The availability of fish per capita per annum in Tripura is expected to be 11.95 kg by the end of 2011-2012.

Environmental Damage to Ennore Coast and the Pulicat-Ennore Complex

Continued from P. 52

ha, of which 15,000 ha are in Tamilnadu. (There is a proposal to include this in the "Ramsar site"). It is recognised as a bird sanctuary by the Tamilnadu Government. It is a source of fish and exportable shrimp. The Pulicat Lake, Ennore Creek, Buckingham Canal and the sea are an interconnected system in which marine organisms have ingress from and egress out of the sea. Larvae of fish and shrimp enter the lake *via* the openings or 'bars', (one at Mukhadwaram near Dhoni revu, Pulicat and the other at Ennore). The fishery of Pulicat Lake largely depends on the Bay of Bengal for inflow of larvae and juveniles of fish, prawns and edible molluscs and for enriching the productivity of the backwater (Krishnan P & Sampath V., 1972. Seminar on Mariculture and Mechnized fishing, Dept.of Fisheries). The Ennore Industrial Infrastructural complex covers some very ecologically sensitive villages like-Kattupalli Island, Kalanji, Puzhudivakkam, Vayalur etc. Among these, Kattupalli is surrounded by Ennore creek, Buckingham canal, Pulicat Lake and the sea. It has a rich biological diversity, both fauna and flora. This is very much in CRZ I and so should preclude all industrial activities. Even the request for a licence for setting up a shrimp farm was refused on this ground. Kattupalli has freshwater aquifers at 2-3 m depth. Geologically it is in the 'Coramandel Formation', ideal for freshwater aquifers. Even paddy is cultivated, let alone the existence of cashew plantations, coconut trees, palmyra, banyan etc. Avian fauna is also present. This is the only 'Green Spot' in the highly industrialised North Chennai zone, according to the WWF.(Fig.3)

In this complex, species of algae, inclusive of agarophytes and alginophytes, consists of 8 cyanophyceae, 7 chlorophyceae, 12 rhodophyceae, and 42 bacillariophyceae. The once abundant aquatic vegetation has now declined. There are 60 species of plants belonging to 13 genera in the lake zone. Halophytes like *Salicornia* abound in this area. *Sueda nudiflora, S.monoica* and quite a few medicinal plants occur in this ecosystem. Mangroves like *Avicenia marina* are also present. These marshes are the nurseries of numerous aquatic animals. Freshwater sources in Kattupalli island have the river prawn, *Macrobrachium malcolmsonii*, carbs, snails (*Pila globosa, Planorbis exustus*) mullets, Notopterids etc. In the brackishwater zone six species of prawns 25 species of fishes (including the mud skipper *Periophthalmus* sp.), mudcrabs (*Scylla serrata, S. tranquebarica*), fiddler crab etc., occur.

The Buckingham canal (submerged by Pulicat Lake and Ennore backwaters) is connected to the sea in other places south of Ennore also, through Cooum river, Kovalam backwaters, Pudupattinam River, Palar river, and Adyar river. All these facilitate the entry of fish and crustaceans from Bay of Bengal, thereby enriching the fishery of backwaters. North of Ennore, Kortalayar, Araniar and Swarnamukhi rivers empty into the Bay of Bengal crossing the Buckingham canal, Pulicat Lake and Ennore backwaters. The entire aquatic system with the rich fishery will be affected by the proposed industrial development ("Petro Park").

From the fishery point of view, sea erosion, dumping of fly ash and discharge of hot water etc., make the inshore area unfit for fish life. Tiruvallur coast does not have any mechanised boats operating. There are non-mechnised and motorised craft only. Hence they cannot go out to offshore for fishing. They are denied utilisation of fishery in the near shore waters because of pollution. The value of the fishery is about Rs.one billion. Any damage to the coastal ecosystem off Ennore-Pulicat will drastically reduce the fishery of Bay of Bengal, with 90% of the fish constituting the fishery depends on the mangroves as nursery area. The FAO has recognized the "threat to Bay of Bengal marine ecosystem from port construction, resort construction, tourist facilities development of industries, not to mention sand mining" (BOBP NEWS 11(15);23, 1999).

There has to be a 'before and after' studies on the fishery and environmental aspects of the complex coastal system. It is doubtful if the State Fisheries Department or the Central Fisheries agencies are paying any attention to this to sustain a good fishery in Ennore-Pulicat coastal area. Instead of the 'Petro Park', an 'Aqua Park' must be developed to nurse, develop and restore the aquatic resources of this area. S.Ramachandran, Director, Institute of Coastal Management, Anna University, poses the question "Once a coastal or marine ecosystem is allowed to die it is gone. We cannot get it back. Should we allow the Ennore Creek to become the Dead Sea of India ?". In Kerala 400 acres of land allotted for industrial park in Vypeen Island was cancelled after environmentalists opposed it. Gujarat High Court ruled that the Sanghi's Jetty in Kutch should not be constructed at the site chosen because of adverse effect on the mangroves (*Business India* March 21-April 5, 1998). The Supreme Court ordered the need to protect the ecological fragility of Dahanu and the Maharashtra Government also notified that no polluting industry would be allowed within 25 km radius of Dahanu. The Supreme Court order says "We have no hesitation in holding that the Precautionery Principle and the Polluter Pays Principle are part of the environmental laws of the country".

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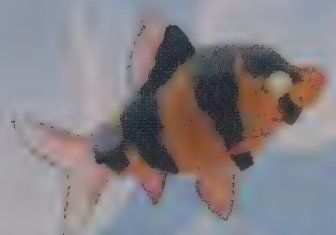

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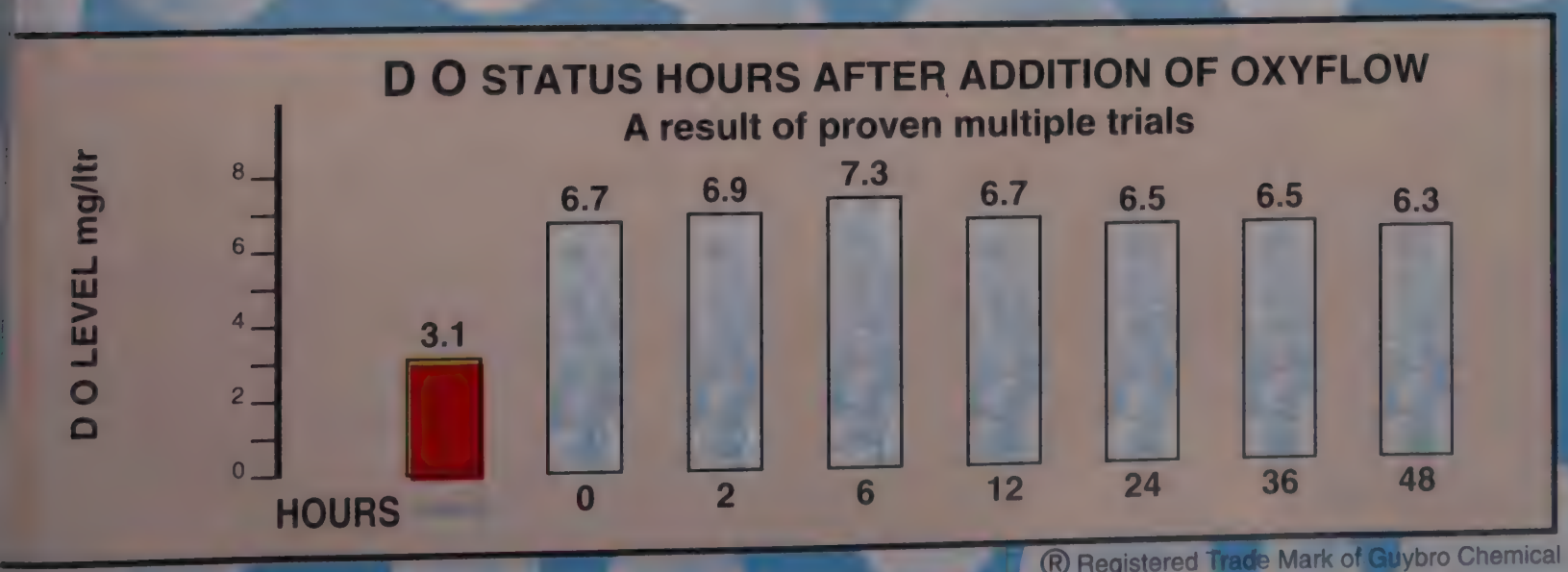

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Changing Scenario of Fisheries Activities in Himachal Pradesh

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Bilaspur - 174 001

Himachal Pradesh is blessed with a number of fast-flowing torrential rivers viz., *Beas, Sutlej* and *Ravi* originating from permanent glaciers, rumbling and wirling down the rugged mountains over awesome gorges and fiery rapids. These linearly flowing waters having a maze of tributaries and branches dissect many climatic zones in their downward drift and harbour one of the richest cold water fish fauna of the country. Besides, there are several natural/man-made lakes and reservoirs, and small ponds dotting the entire region. About 218 exotic and indigenous species of fish occur in the natural waters of the State. Amongst them, 33 major species can be brought under four major groups viz., (i) Loaches (family:Cobitidae), (ii) Lesser barils (family: Cyprinidae), (iii) Snow trout, Mahseer and minor carps (family: Cyprinidae; sub family: Cyprinae) and (iv) Catfishes (family: Sisoridae; sub family: Rasborinae).

The fisheries activities provide seasonal and full time avocation to over 10,000 fishermen. Owing to the efforts made by the department, the fish production of the State has reached a level of over 8000 t annually.

An account of fisheries of Himachal Pradesh, resource-wise, is given here under.

Reservoir Fisheries

Reservoirs viz., Gobind Sagar and Pong dam (Maharana Pratap Sagar) of Himachal Pradesh with, meanwater spread of 25,000 ha constitute an important fishery resource of the State. The development of fisheries on scientific lines in these ecotopes have shown their tremendous potential for food production and generating employment. Because of a series of management measures taken by the State Fisheries Department, a total of 26,140 tonnes of fish valued Rs. 4358 lakhs was harvested from these two impoundments during the last two decades. This has also helped in providing viable vocation to over 3,000 fisher families, constituting about 20% of dam's oustees, on sustained basis. The State Government too realised from fishing activities an income of Rs. 699.36 lakhs by way of royality, fee, fines etc. During 2000-02 alone a total of 1,600 tonnes of fish valued Rs.506 lakhs was harvested by 2,954 fishermen from Gobind Sagar and Pong reservoirs. The department's income during a single year alone (1997-98) was Rs. 72.0 lakhs.

Further, while Gobind Sagar is maintaining an unique distinction of yeilding the highest per ha fish production (over 101.1 kg/ha.) in the country for over one decade, the Pong reservoir fishermen are getting the highest per unit price for thier catches at landing sites (Rs. 48-70/kg.) in the country. In view of these two characteristic features, while the fishermen of Gobind Sagar have benefited by continuous increase in total catch over the years the steep increase in the price level of the harvest gave higher incomes to fishermen of Pong reservoir The fish fauna of both these water bodies differs widely. While Gobind Sagar is exclusively a Carp reservoir, the Pong reservoir is predominantly a Catfish reservoir.

Gobindsagar Reservoir : The Gobind Sagar reservoir came into existence with neither established fish stocks nor planned management. Its natural stock consisted of Mahseer (*Tor* spp.,) *Schizothorax* spp. and other mountain rheophilic fish species. A consignment of Gangetic major carps was released in 1961. Mirror carp, *Cyprinus carpio* var. *specularis*, an exotic cold water species was introduced into the newly created reservoir during 1962.

Presently, there are 51 species (subspecies, varieties) of fish recorded from Gobind Sagar reservoir. These belong to following nine families:-

(a)Family Cyprinidae: *Barilius bendelisis, B. yagra, B. barila, B. modestus, Oxygaster bacalia, Rasbora daniconius, arassius carassius, Cirrhinus reba, C.mrigala, Crossocheilus latius latius, Catla catla, Labeo dero, L.dyocheilus, L.bata, L.calbasu, L.rohita, Cyprinus carpio* var. *communis, C. carpio* var. *specularis, Schizothorax richardsonii, S. plagiostomus, Ctenopharyngodon idella, Hypophthalmichthys molitrix, Tor putitora, Garra gotyla gotyla, G.lamta, Puntius sarana, P. ticto* and *p.sophore.*

(b)Family Cobitidae: *Botia dario, B.dayi, B.birdi, B.lohachata, Nemacheilus botia, N.rupicola, N. montanous, N.kangrae* and *N.horai*

(c)Family Bagridae: *Mystus Seenghala* and *Bagarius bagarius.*

(d)Family schilbediae: *Clupisoma garua.*

(e)Family Sisoridae: *Glyptothorax pectinopterus* and *G. cavis*

(f)Family Ohpiocephalidae: *Channa marulius* and *C. punctatus*

(h)Family Mastacembelidae : *Mastacembelus armatus armatus.*

(i)Family Salmonidae: *Salmo trutta fario.*

A persual of indigenous carps composition in the total catch from 1975

through 1993 indicates that their proportion increased till 1978. This has been followed by a decline, reaching the lowest level of 13.9 per cent in 1987. This percentage during 1988-94 ranged from 8 to 10 per cent. The decline is especially pronounced in Indian major carps and minor carps (CIFRI,1986). *Labeo rohita*, a commercially high value fish, has undergone a steep decline in the catches since 1979. Its percentage composition in the reservoir increased progressively from 7.7 to 23.5 percent during 1975-78, but later declined to 1.2 per cent in 1987. This was mainly due to inadequate recruitment and wanton killing of brooders during their breeding season from 1977 to 1982. Its percentage in the catches during 1988-93 ranged from 5.0 to 10.0. A greatly sought-after fish, *C. Catla* suffered the same fate. However, its catches in total landings underwent an increase from 23.0 to 31 percent during 1975-1977, but later started declining, and during 1988 only 4.2 per cent of the total fish landings were represented by *C.catla* However, the percentage increased to 9.0 during 1992-93. Catches of *C.mrigala* also initially increased from 2.2 to 16.8 per cent (1976-79), after which a period of steep decline followed, ebbing to 0.46 per cent in 1993. *Labeo calbasu* contributed only minor proportion in the total catches, fluctuating between 0.03 and 0.5 per cent during the last 19 years. In 1975, their percentage in the total catches was 0.5 per cent while during 1992, it was 0.2 per cent.

The total catch of the Indian major carps initially increased from 39.6 percent to 81.8 percent. Afterwards the catches declined and in 1988 the percentage composition reached a low of 0.497. Subsequently, it showed marginal increase and contributed 10.2 per cent during the following years. The minor carps are represented mainly by the hill stream species, *Labeo dero, L.dycheilus, L.bata, C.reba* and *P.sarana*. The percentage composition of these fishes increased in the reservoir until 1982, but thereafter decline started. The percentage composition of minor carps reached an all time low in 1989-90 (1.2 %). The percentage during 1990-91 to 1995-96 ranged from 3.5 to 7.5.

Silver carp, grass carp and common carp constitute the exotic fish fauna of the reservoir. In recent years, exotic carps due to their prolific breeding, have monopolised the whole lake (> 80%) exhibiting thereby the growth rate of 8.2 per cent per annum for the last 19 years.

Silver carp could make an inadvertent entry into the reservoir in 1971 because of inundation of one of the fish farms of the State Fisheries department (Deoli Fish Farm), when 47 specimens ranging from 290-530 mm (0.5 to 2.5 kg.) were washed out. The species started appearing in the catches of Gobind Sagar during 1976-78 and specimens of 300 mm size appeared in 1976. In 1977, there was a substantial catch (10 t) of silver carp accounting for 1.4 per cent of the total reservoir landings (Jhingran and Natarajan, 1978). The fish continued to reproduce and in 1989-90 silver carp landings reached a total of 661 t. The maximum catches were recorded in the low temparature lotic sector of lake.

Mirror carp also constitutes an important fishery of Gobind Sagar. Massive seed production of this exotic carp,has enabled regular stocking of the reservoir with seed of the fish by the department of fisheries since 1965. This species attains an average size of 0.8, 1.4, 2.2 and 3.1 kg in its first, second, third,and fourth year, respectively. However, the reservoir, being bereft of weeds which serve as substrate for attachment of carp eggs, autostocking has not been observed in the reservoir.

The major carnivorous fishes in the reservoir, Mahseer (*T.putitora*) and the cat fish *M.seenghala*, have shown a declining trend over the last 19 years. In 1974, the total landings of these two species were 31.8 t (18.6%), whereas in 1987 it was 34 t (6.3%). Percentage of these fishes during 1992-93 was recorded at five. The highly voracious fish, *M.seenghala* has kept a low profile in the reservoir as reflected in the catch structure (0.4-4.0%). *T.putitora* the prized game fish, constituted a major fisheries in the river *Beas* prior to the reservoir's impoundment. Its percentage contribution has dropped from 16.7 to 5.8 per cent (1974 to 1987), but the yield in terms of landings has not markedly changed, when compared with the catch from the first few years of the impoundment i.e., in 1974-76. The catch was 37.8 kg, compared with 31.4 kg in 1984. The major factor which has been negatively affecting the population of this fish seems to be the illegal fishing for juveniles. During 1987-88, 54,662 masheers of less than 1.0 kg weight each, accounting for 84% of total catch, were harvested in the reservoir. This shows that the recruitment rate of this species must be still high. This is offset by fishing of immature fish which has resulted in a decline of the stock. In 1992-93 alone, 45.2 t of masheer, which accounted for 4.7 per cent of the total catch, was harvested from the reservoir. However, the average weight per fish recorded was only 0.634 kg.

Pong Reservoir: The fish fauna of the Pong reservoir during the initial stages consisted chiefly of catfishes, minor carps and few coarse fishes mainly residual and acclimatised from the river.

A token consignment of 1.3 lakh fingerlings of minor carp were stocked in the reservoir during June, 1974. Later during 1976-77, 1.49 lakh Indian major carp seed was procured and stocked after rearing to fingerling size. This practice continued in subsequent years, though in an interrupted manner. Meanwhile, the seed produced in the departmental farms, mostly of *Cyprinus carpio* var *specularis* and *Cirrhinus mrigala* was also stocked regularly in the reservoir. The commercial fishing in the reservoir was initiated soon after its emergence. The total catch during the first year of fishing operation was 98.1 t and it increased progressively, attaining a peak of 797.4 t during 1987-88. During the intervening period (1977-78 to 1986-87), the landings fluctuated within a narrow range of 443 to 596 t. In the

ear 1988, due to incessant rains and eavy floods, the water level of the res- voir reached an alarming level of 42 m and forced the dam authorities to pen the flood gates. This caused heavy scape of fish from the reservoir affect- ng thereby the catches in the following ears, which plummeted to 475.8 t dur- ng 1988-89, and increased marginally o 489.2 t during 1989-90 but later the atches fluctuated between 400 to 500 onnes.

A total of 27 fish species (sub-spe- ies, varieties) belonging to following ix families have been recorded from the ong reservoir:

Family Cyprinidae: *Barilius bendelisis, B. vagra, Cirrhinus mrigala, Crossocheilus latius, Catla catla, Labeo dero, L.bata, L.rohita, Cyprinus carpio, Schizothorax richardsonii, Tor putitora, Puntius ticto, and P.sarana*

Family Gobitidae: *Botia birdi, Noemacheilus kangrae*

Family Bagaridae:*Mystus aor, M. seenghala, Bagarius bagarius, Wallago attu*

Family Sisoridae: *Glyptothorax pectinopterus, G. gharwali*

Family Channidae : *Channa marulius, C striatus, C. cephalus*

Family Mastacembelidae: *Mastacembelus armatus*

L.rohita, M.seenghala. L.Calbasu, T.putitora, C.mrigala, W.attu, C.carpio, L.dero, C.catla and Channa sp. are the commercially important species of the reservoir (in order of abundance).

Indigenous carp composition in the total catch was increasing until 1987-88, followed by slight decline registering a level of 51.4 per cent of the total catch during 1989-90. All the four Indian major carps i.e. *Labeo rohita, C.mrigala, C.catla* and *L.calbasu* are present in the reservoir. *L.rohita* has undergone a steep increase in the catches since its transplantation with a range of percentage composition from 0.4 to 42.5 per cent (1982-83 to 1987-88). The respective percentage during 1988-89 and 1989-90 was 30.5 and 34.4. *C.catla*, in fact, never got adequately established in the reservoir. The reason for this can partly attributed ot the fact that stocking efforts were also hardly adequate. The percentage of this fish in the total exploited fisheries ranged from 0.04 to 1.6. The composition of *C.mrigala* increased from 5.3 per cent to 9.7 per cent form 1982-83 to 1987-88. In the case of *C.catla*, the increase was negligible (0.4 to 1.0%), while in case of *L.calbasu* and *C.mrigala*, the percentage composition remained static between 17.1 and 10.3 and 5.3 to 5.1 resepctively..

The minor carps in the reservoir are represented by hill stream species, *L.dero, L.dyocheilus, P.ticto* and *P.sarana*, etc. In case of L.dero, the percentage composition declined from 14.3 to 2.6 while other species either disappeared or showed erratic appearances in the catches.

Cyprinus carpio var *specularis* is the only exotic carp available in the reservoir. Despite heavy stocking, the fish has kept a low profile and its percentage fluctuated between 6.8 and 5.9. An all time low of 2.6 per cent was recorded during 1989-90.

The major carnivorous fishes of the reservoir are *T.putitora, M.seenghala, W.attu* and *Channa* spp. The cummulative percentage of carnivores, which stood at 55.8 during 1982-83, declined to 38.6 during 1989-90. *T putitora* which contributed 20.3 percent of the catch during 1982-83 dropped to 11.0 per cent during 1989-90. Similarly, in case of *M.seenghala*, the percentage composition decreased from 28.5 to 21.7 during the same period.

The production details of both the reservoirs are furnished in Table 1.

Riverine Fisheries

Rivers are linear systems which serve to evacuate water falling on continental masses towards the oceans. As per rough estimates, riverine fishery resources of the State have been estimated at a length of 3000 km including 600 km of trout waters. The State's rivers show clear-

Table 1 : Production particulars of Gobind Sagar and Pong Reservoirs

Year(s)	*Production range (in tonnes)*	*Total Production (in t)*	*Average yearly Production* (in t)	*Yield (ha)*	*Value of fish (Rs. in lakhs)*	*Total amount realised by the dept. (Rs. in lakhs)*	*Yearly income (Rs. in lakhs)*
Gobind Sagar							
1981-82 to 1990-91	377-816	6.805	680	68.0	473.94	71.63	7.16
1991-92 to 00-2001	855-1082	10.109	1011	1,011	1.842.84	291.71	29.17
Pong Reservoir (Maharana Pratap Sagar)							
1981-82 to 1990-91	442-797	5.166	516	34.4	623.07	99.46	9.95
1991-92 to 00-2001	330-485	4.060	406	27.06	1.481.15	236.56	23.66

cut zonation and as such can be classified in to rhithron and potamon. The rhithron is the region extending from the source to the point where mean monthly temperature does not rise beyond 18° Celsius, oxygen concentration is high, flow is fast, turbulent, and substratum is formed by rocks, stones or gravels with occasional sandy or silty patches. Potamon region is characterised by high temperature (20°C), limited dissolved oxygen (2-4 ppm) and muddy or sandy bottom.

The main morphological characteristics of these zones are alteration of the pools and riffles which rise form changes in gradient. The steeper epi-rhithron is dominated by rapids, waterfalls and cascades but as the river proceeds downstream, the proportion of pool-like reaches relative to the riffles increases and eventually the hypo-rhithron merges into potamon. The coldwater streams and lakes of Himachal Pradesh are characterised by high transparency, good dissolved oxygen content and different biota. Most of the cold water species are small sized. This shows a distributional pattern that depends on the rate of flow of water and nature of substrata. Riverine stretches of the State falls under two categories viz., (i) Sport waters & (ii) General waters.

Sport waters: Himachal waters are known world over for excellent catches of game fishes, Masheer and Trout. However, the recent years have witnessed depleting trends in the catches of these game fishes. The major reasons which have led to this state of affairs are:

- Emergence of series of river valley projects;
- Construction of dams, abstraction of waters;
- Road construction activities, denudation of forests, ecological erosion.
- Deterioration in water quality of rivers due to siltation, pesticidal contamination and human intervention.
- Fast shrinking of feeding and breeding grounds of fishes.
- Clashes between commercial fishermen and anglers, and
- Destructive fishing methods.

The ecological changes brought about by the river valley projects have affected both the migratory and non-migratory riverine species. Fishes occuring in State's waters are resident as well as local migrants. The resident fishes may be *Channa*, spp *Mastacembelus* spp., *Garra* spp., *Labeo* sp., *Crossocheilus* spp., *Noemacheilus* sp., *Glyotothorax* spp., and the local migrants *Schizothorax*, *Mystus*, *Bagarius* spp., Masheer & Trout.

The denial of migratory movement to migratory species has resulted in reduction of stock of these species. It is unfortunate that even a minimum flow of water which could provide requisite shelter is not maintained in the tail area of dams. The rapid road construction and removal of forests have made the valleys naked and fragile. The floods during the rainy season bring havoc and not only scour the aquatic fauna of these rivers but also lead to mass-scale killing of fish.

Heavy silt brought by the rivers, especially during rainy season, render the riverine environment quite inhospitable for the fishes. The silt brought by rivers forms a deep matrix on the riverine beds, forcing the starved fishes to leave the main rivers to search food in the tributaries.

Several workers have highlighted the fast deterioration in water quality of rivers in the State . The rapid urbanisation of villages located along the banks, construction of roads and hydel projects, and denudation of hills have increased the pollutional load of the rivers. A study conducted by Himachal Pollution Board indicates that the *Sutlej* and *Beas* rivers have been most polluted due to human interventions. Over 50 towns and semi-urban settlements in the Sutlej basin generate huge qualities of waste water and garbage. An estimated 83.77 million litres of waste water and 1.492 tonnes of solid waste is dumped into the river every day with additional industrial discharge of 40,140 cum of effluents and 144 tonnes of solid pollutants.

There are about 22 townships in the Beas basin from Manali and Chintpurni generating 65.3 million litres of liquid and 1.940 tonnes of solid waste every day. The twin tourist resorts of Kullu and Manali alone contribute to about 500 tonnes of solid waste per day. Consequently, the quality of water which matches the best designed use upstream of Manali degenerates to "B" and "C" classes at certain stretches close to big towns. Besides, the basin has a large number of pilgrimage places such as Jawala Ji, Kangra and Chintpurni, which attract lakhs of devotees throughout the year. Tourists and piligrims add to growing pollution of the rivers. The mining industry accounts for 144 tonnes of solid waste. The Ravi catchment slate mines, which contribute to over 200 tonnes of solid waste daily, are a major source of pollution. Besides, there are seven main towns which generate about 2 crore litres of liquid and 650 tonnes of solid waste. The quality of water upstream Chamba has deteriorated to even "C" and "D" classes in vast stretches of the river.

Trout Farming

During early nineties a scheme on 'Commercial Trout farming' was formulated and submitted to the Norwegian Government for technical assistance. This "Transfer of Technology" scheme envisaged construction of "modern trout farm" with capacity to produce 2 lakh fingerlings and 120 tonnes of table-size trout annually. Import of quick-growing, disease-resistant trout eggs, development of economical and viable pelletised feed with local ingredients, training of in-service staff and private pisciculturists were the other aspects included under this bilateral project. The Norwegian Government agreed to provide financial grant of 11.80 million Norwegian Kroners for incurring expenditure under consultancies, cost of equipments and training of personnel.

Despite initial set-backs due to unprecedented floods in Kullu valley dur-

ng 1993-95, the undeterred efforts and determination of both Norwegian and Indian personnel succeeded in achieving the desired milestones set under the project. Not only a modren farm as well as hatchery was set up in Kullu Valley but the production goals viz. 10 tonnes of table-size trout and over two lakhs of trout eggs annually were also achieved. Notwithstanding, breeding and production operation of the imported strain was also carried out successfully not only in the farm at Patlikuhl but also in all other trout farms of the State. The survival rate from eyed ova to fingerlings and even table-size fish surpassed the expectations and far exceeded the rate recorded in Norwegian waters. The higher survival rates virtually created a storage problem and in view of limited rearing space at the State's farm, seed had to be transplanted in rivers and streams of the State.

A regular sale of trout fingerlings and table size trout was initiated from 1997-98. Concomitant to this, the State Government initiated a programme on construction of new trout farms viz., at Dhamwar and Bharmour and remodelling of existing farms viz., Barot, Sangla and Nagni. This all helped in undertaking large scale "seed ranching programme of State's streams as well as open sale of table size trout in the farms.

During 2000-01, over 20 tonnes of trout was sold from the State's farms as well as 10 tonnes from private farms. Similarly over one lakh trout fingerlings were stocked in different rivers/ streams of the State. The current year has also witnessed a quantum jump in the sales and stocking programmes. Further, besides meeting the indigenous demand, the State's farms are also supplying trout feed and trout seed to the Government of U.P., Arunachal Pradesh, Uttaranchal, and other National institutes of Cold water fisheries.

The achievements made under the Indo- Norwegian project have been well appriciated at both in India and Norway. The main aim of the project was the promotion of trout farming in the high altitude waters of Himachal. In pursuance of the aim,a detailed study was undertaken on selection of suitable sites for trout farming in Kullu Valley, which helped to pinpointing the strategic spots for establishment of farming units. Later, training programmes were taken up at State's fish farms in order to impart technical knowledge to the beneficiaries. NABARD too held workshops at Kullu for providing loans to interested parties.

The successful implementation of Norwegain-assisted "Trout Farming Project" in Kullu valley of Himachal Pradesh has opened up viable avenues for exploitation of the potential of the vast network of flowing waters for fish production as well as employment generation in the upland areas of the State. Trout, which a decade back was rare to come by is presently available in plentitude in departmental and private fish farms of the State. Several tonnes of trout are now being sold from departmental farms in country's Capital. Recognising the achievement, the Government of India sanctioned a 100 % Centrally Sponsored Pilot Project viz., "Coldwater Aquaculture" for implementation in different hill states viz., Himachal Pradesh, Jammu and Kashmir, Sikkim and Uttranchal involving financial assistance of rupees one crore to each. The project envisages remodeling of existing trout farms of the State; providing liberal subsidy upto Rs. 35,000/- per unit to be passed on to 125 beneficiaries during the current year; setting up of a trout feed mill and preparation of survey reports, stream improvements programmes etc.

In recognition of the success of the bilateral project of Trout Farming, the Norwegian Government under "Institutional Co-operation programme" has sanctioned another Project on "Fish Health and Nutritional Studies" to be taken up jointly by the National Veterinary Institute, Oslo and Department of Fisheries, Himachal Pradesh.

The project focuses on upgradation in research and training for redressal of problems relating to fish diseases in trout farming *vis-a-vis* arresting fatalities occuring due to diseases. The project aims at establishment of first-ever National Laboratory on Pathology of Coldwater fishes catering to the needs of all the hill states of the country. Besides conducting studies of identification, enumeration and cataloguing of various diseases emerging in trout hatchery, it would also help in raising a team of extension officers who would help trout fish farmers in controlling disease infestation.

Under the scientists-exchange programmes, the State personnel would visit leading Norwegian institutes while Norwegian scientists would visit Himachal Pradesh and work at the State fish farms. The exchange programme would obviously help the State's personnel to acquire requisite expertise in the field of fish health and diseases and finally would help the State in emerging not only as a pioneer in trout farming but also the leading producer of trout in the country. The project would be funded by Norwegian Government.

General Waters

Sehgal *et al.* (1978) recorded 66 fishes from various rivers, streams and tributaries of the State. According to them, the commercial fishing activities in the upland streams of Himachal Pradesh are primarily of subsistance type. Individual catches landed by local fishermen are taken in the nearby locality to earn livelihood. Organised marketing of fish does not exist in view of meagre catches of small sized coldwater fishes. Each year, department of fisheries issues about 10,000 licences to professional fishermen on annual basis on payment of a fee of Rs.50/-. The average catch per fisherman in Himachal Pradesh streams ranges from 2-4 kg/person.

Aquaculture

Sustainable aquaculture is one of the best means of ensuring diversificationn of land and water use, and providing training and employment to unskilled rural youth. The present quality of management is so low that optimal sustainable production from even the natural

waters is not fully realised. The reason for this is that all the avilable technologies associated with aquaculture are suitable only for warm water fishes cultured in the plains.

There are about eight species of carps, two species of catfishes and two species of salmonids which are potentially suitable for farming in hill States of the country. Majority of these species could not be bred and no viable technology for their large scale breeding has yet been developed by the research institutes of the country.

Mirror carp *(Cyprinus carpio* var *specularis)*, Rainbow trout *(Salmo gairdnerii)*, Silver carp *(Hypophthalmicthys molitrix)* are the only species which are bred and reared in the hill states. The other fishes viz., *Tor putitora, Schizothorax spp, Mystus seenghala, Wallago attu, Labeo dero*, though much in demand are still caught from wild and are neither bred nor reared in the farms.

Aquaculture, in fact, has been introduced recently in Himachal Pradesh. Till 1980s, the fisheries of the State remained mainly "Capture" in character and it was only during 1983 that the aquaculture activities were started through a centrally sponsored scheme and setting up of Fish Farmer's Development Agency. Its promotion, however, is confronted with multiple problems viz., porosity *vis-a-vis* low clay content of the soil, hilly terrain, low retentivity of water on the one hand and absence of culture model of compatible species suitable for stocking in stagnant upland waters on the other. Further, standard technology in large scale breeding of hill stream fishes viz., mahseer and *Schizothorax* spp is lacking. The aquaculture in hill states, therefore, remained limited to monoculture of mirror carp *(Cyprinus carpio* var *specularis)*. The production level in the wild and managed ponds ranges from 800-1700 kg/ha. The two Fish Farmers Development Agencies set up in the State are presently engaged in the promotion of Aquaculture. However, the programme has failed to make any significant inroads into the rural areas of the State, mainly due to poor returns and lack of extension activities.

The complex topography of Himalayan States is hardly suitable for stagnant water pond culture. Flow-thru Culture or Running water fish culture offers an unique opportunity of undertaking fish culture in plentiful of flowing, oxygenated water. The basic principle of "flow-thru fish culture" lies in intensive stocking and fish raising in barricaded longitudinal stretches, with well guarded inlet and outlet set up across flowing water channels. The raceways ranging from 50-200 m with average depth ranging from 0.7-1.2 m are constructed. The flow of water varies from 200-400 litres/second. The mirror carp is the most favoured fish for running water fish culture mainly due to its eurythermal and hardy nature, easy and large-scale availability of fingerlings, acceptability of artificial feed, quick-growing and above all, favourable response from consumers. With a stocking density of 50-100 per m^2, the ongrowing fingerlings attain size of 300-400 g with a supplementary feed comprising wheat bran 30 per cent, oil cake 30 per cent and powdered maize 40 per cent.

The first Running Water Unit on the lines mentioned was established in a departmental fish farm at Bilaspur during 1991. A raceway of the size of 30m x 2.5m x $1m^2$ was constructed with successful rearing of mirror carp. The biomass of fish netted out from a 80 m area of raceways at stocking density of $62/m^2$ and after rearing for seven months was 350 kg. The department initiated a State-level scheme which included allotment of 1,500 square feet to eacg of the beneficiaries at the rate of Rs.4,000/- per unit besides training and supplies of inputs such as seed and fish feed to the beneficiaries. The scheme has been well received in the rural pockets of the State and about 1030 units have already been set up so far.

Research and Development Needs

1) In view of scanty information on the resources of coldwater fisheries in the uplands, detailed survey needs to be taken up on top priority for development of capture and culture fisheries.

2) Geographical distribution, substratum, physical and chemical conditions of stream, benthic invertebrates, predominant nektonic forms and longitudinal zonation of upland streams need to be investigated for proper understanding of ecology of stream and its impact on fish life.

3) Grading a stream based on number/net weight of biomass/volume associated with stream size, distribution and nature of pools may facilitate determination of the number of trout transplants required to be stocked for recreational fishing. The turnover rates of various organisms constituting benthic biomass need be investigated. This would enable determination of the extent of utilisation of these organisms by fish and establishing co-efficient of accessibility (GA) or availability factor or forage ratio.

4) The existing fishing methods in riverine systems are of primitive nature. Turbulent and deep gorges especially in the head waters make cast net fishing impossible. The most immediate requirement is therefore to introduce fishing gears well-suited for turbulent streams.

5) With standardisation of trout hatchery techniques, considerable research is needed to produce disease-resistant healthy stocking material for meeting recreational and commercial requirement. This involves large scale seed production of trout, prophylactics against diseases, improvement of existing stocks of brown and rainbow trouts by selective breeding etc.

6) There is an urgent need of selective introduction of fast growing strains of lake trout, Arctic char, brook trout, brown trout and Donaldson's and Hampshire strains of rainbow trout to enhance trout yield for meeting the requirement of commercial farming of trout.

7) To meet the challenge of near-ex-

ction of germplasm of nizothoracids and mahseers, research evolving hatchery and culture prac-es and artificial diets should receive priority for producing stocking ma-ial to be transplanted in the depleted ural waters. The fruits of transplants be reaped, only when considerable public awarness is created for conserv-ing stock of endemic fish.

8) The technology of extensive and intensive culture of German phenotypes of common carp in the Shivalik zone of the Himalaya and Deccan Plateau has to be developed. The intensive culture lines includes common carp cul-ture in running water ponds and cages anchored in lakes and reservoirs. Intensive research efforts need to be made to evolve certain cold-resistant hybridization for utilising vast areas of high altitude zones of Chamba, Mandi, Kinnaur, Kullu and Solan for fish culture.

NBSAP - EAST COAST ECO - REGION WORKING GROUP

Workshop - Cum - Discussion (Andhra Pradesh Sector)

A one day Workshop on National odiversity Strategy and Action Plan BSAP) was conducted at the State stitute of Fisheries Technology, kinada, on 16th November 2001. This orkshop helped in popularising the ocess of NBSAP and highlighting the forts made by the Ministry of Environ-ent and Forests, Government of India the preparation of suitable action plan r the conservation of our national odiversity including that of the marine vironment for sustainable utilisation.

In the Workshop, 119 representatives om different research institutes, govern-ent, non-government and women's or-anizations took part. The deliberations f the workshop were made mostly in the cal language, to enable all the partici-ants including fisherfolk and common ublic to understand the purpose of the rogramme and the need for their par-cipation to move towards NABSAP.

Mr. H.V. Krishnamaraju, Vice-Prin-ipal, SIFT, Kakinada welcomed the par-cipants. Prof. L. Kannan, Director (Re-earch), Annamalai University and Co-rdinator, NBSAP East Coast Eco-re-ion Working Group, gave an overview f the National Biodiversity Strategy and ction Plan. He explained the various omponents of the NBSAP including its oals, scope and progress. He also pre-ented the various activities of the work-ng group, right from the commence-ent of the NBSAP programme, such s: 1) Identification of working group embers for the States of West Bengal, Orissa, Andhra Pradesh, Pondicherry nd Tamil Nadu; 2) Preparation of a questionnaire, for getting inputs for the conservation of coastal, marine biodiversity from different sections of people, from different parts of the east-coast of India, including the Andaman and Nicobar islands; 3) Participation by the Co-ordinator at: (a) brainstorming session of the National Biodiversity and Action Plan Programme in the Institute of Forest Genetics and Tree Breeding at Coimbatore; (b) UGC-sponsored National Seminar conducted in the Department of Rural Development, Annamalai University, Annamalainagar to chair a session and deliver a talk on Remote Sensing application in Marine Biodiversity; (c) inaugural function of the Marine Biodiversity Park in the Global Village at Manora at which a lecture on Marine organisms and their environment is to be delivered; (d) Eco-club of the T.B.M.L. College, Porayar to give a lecture on Marine Biodiversity Conservation for the benefit of the college students and teachers and (e) State Level School Students' Exhibition held at Thanjavur for the benifit of the students, teachers and common public; 4) Conduct of a Workshop-Cum- discussion and Brainstorming session at CAS in Marine Biology, Parangipettai and 5) To conduct a boat rally at Parangipettai (Tamil Nadu) to emphasise the need for conservation of marine biodiversity and the protection of livelihoods of local fisherfolk, followed by an interactive meeting and cultural programme.

The invited speakers gave their views on different marine resources, ecosystems, socio-economics and management practices.

Dr. K. A. Narasimham, Principal Scientist (retd.), Central Marine Fisheries Research Institute, Kochi explained that the major production centre for bivalves and gastropods in Andhra pradesh was Kakinada Bay with an annual production of 3,065 to 6,020 tonnes. He opined that formal management activity was not required if windowpane oysters and blood clams were collected by hand picking, instead of dredging, as a fishing method. He emphasised the need to identify the hot spots where the health of the environment and the species diversity were declining so as to take immediate remedial action. Dr. T. Rajyalakshmi, former Director, Central Institute of Brackishwater Aquaculture - ICAR as well as the Chairman of the Kakinada branch IARF, gave an account of the management aspects of the coastal zone where land, sea and air were having constant interaction, in addition to defining the coastal zone.

Dr. H.M. Kasim, Principal Scientist, Central Marine Fisheries Research Institute, Kakinada, explained the issues and problems relating to marine fisheries and also some action plans, as follows:

1) **Issues and problems** : a) Increase in demand of fishes due to growth of human population and increased market demand: b) indiscriminate fishing with improper gears and methods, and c) biological by and economically undesirable exploitations leading to stock depletion.

Continued at P.90

Status of Fisheries Development in Karnataka

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Karnataka emerged as a maritime State in 1956 with the reorganisation of states. An independent Department of Fisheries was set up during 1957. Since then, the department has been consistently imparting technical guidance and creating awarness among fishermen in respect of improved methods of fishing, besides implementing developmental schemes. As a result there has been an increasing trend in fish production of the State.

Marine Fisheries Sector : General Features

The State has 300 km of coastline, and 27,000 sqkm of continental shelf area, rich in pelagic fisheries resources. Out of the Indian EEZ of 2.02 million sqkm, Karnataka has a share of 87,000 sqkm. Traditionally, Karnataka coast is known as mackerel coast. The marine fisheries resource potential of the State is estimated at 4.25 lakh mt, of which 2.25 lakh mt are worked out to be from inshore zone upto a depth of 70 meters and remaining 2 lakh mt from the off shore/deep sea zone.

The pelagic fishery wealth of Karnataka coast mainly comprising mackerel and oil sardine used to be traditionally harvested operating giant shore seine known as "Rampani" but this method is now obsolete. The mechanisation of fishing operations was initiated with the introduction of 30 ft. to 43 ft. trawlers in 1960s for exploiting inshore demersal fishery including shrimps. Introduction of purse seiners in 1970s enhanced the area of fishing operation and pelagic fish landings. Motorisation of traditional crafts, long lining and encouragement of off shore voyage fishing beyond 50 metres depth using bigger vessels for a duration of 4 - 5 days have effectively enhanced the range and effort of fishing operation. Further, financial institutions extended the required loan facilities for acquiring fishing boats which has had the effect of enhancing fleet strength. At present there are 2648 trawling boats, 348 purse seiners, 3708 gill netters, 67 other mechanised boats, 19,088 non-mechanised boats operating in the State. In recent years fishermen have been trained in operation of sophisticated electronic equipments in fishing and navigation.

Marine fish production from Karnataka coast is subject to fluctuations. During 1996-97 it was 2.23 lakh tonnes and the production during 2000-01 was 1.78 lakh tonnes.

As the marine fish landings from inshore waters has reached a maximum sustainable yield (MSY) level, the department has enbarked on stepping up the ongoing efforts for augmenting inland fish production by encouraging sustainable intensification and expansion of fish and crustacean culture production.

Fishing by mechanised boats during monsoon i.e., from 10th June to August 15th is prohibited under the provisions of Karnataka Marine Fishing Regulation Act. At a meeting of the Directors of Fisheries of West Coastal States held at Mangalore during September 1998 it was decided to have a uniform ban on monsoon fishing throughout the West coast. Accordingly Karnataka and Maharashtra States have prohibited fishing from 10th June to August 15th of e ery year in the territorial waters alo their coasts.

The State Government is supplyi 50,000 kl of diesel oil, totally exempte from sales tax, to the mechanised fis ing boats every year so as to render t fishing operations economical and encourage off-shore fishing. In additio the Central government helped the fis ermen by exemption of diesel oil su plied to mechanised fishing boats belo 20 m OAL from payment of Central e cise duty.

Infrastructure Development

The State has given importance f the development of infrastructure facil ties like fishing harbours, landing cen tres, auction halls, and to the setting u of ice plants, cold storages, freezin plants and frozen storages. There ar five fishing harbours in the State on each at Karwar, Tadri, Honnavar, Malp and Mangalore, besides 28 fish landin centres. Construction of fishing harbou at Gangoli is being taken up. Fish land ing centres at Kodibengre, Hejmadiko have been completed. It is proposed t take up construction of fish landing cen tres at Belekeri, Alvekodi with centra assistance and at Belambur and Kode with NABARD's assistance. Extensio of wharf at Mangalore and Karwar fish ing harbours also has been taken up. I order to provide alternate infrastructur facilities because of the coming up of Se Bird naval project, Karwar, constructio of fishing harbour at Amdahalli at a estimated cost of Rs 1032.00 lakhs ha been initiated. The somewhat decreas ing trend in marine fish landings ar hopefully expected to increase becaus of allround efforts made including pro vision of additional infrastructure facil ties.

In order to equip marine fishermen safe navigation and so as to identify ning grounds in the sea, the granting subsidy to a maximum of Rs. 34,000 each fishing boat for purchase of electnic equipments like eco sounder, ra- telephone, GPS navigator etc., has en provided for.

For quick transportation of fish in gienic condition from the landing cens to marketing places, 25% subsidy to a maximum limit of Rs. 25,000 is ovided for the purchase of three eeler tempo-rickshaw to a group of 5 persons to transport fish for marketg.

Fishermen's Co-operatives

The first fishermen co-operative soety was registered in 1951 at Karwar. 1956 Karnataka had 39 marine and inland co-operative societies with one istrict level fish marketing federation Mangalore. However, at present there one State level Co-operative Fishers Federation at Mysore and two Disict level co-operative Fish Marketing ederations at Mangalore and Karwar. here are 368 Primary Fisheries Co-opative Socities in the State with 19,095 members and a total paid up are capital of Rs.15.04 crores. These ocieties are engaged in fish production, xploitation, marketing and allied activies.

o-operative Fisheries Projects: There re two District Co-operative Fish Mareting Federations, one in South Kanara istrict and another in North Kanara istrict. These Federations are engaged ice production for supply to fisherhen, sale of diesel oil and lubricants, esides sale of fishery requisites to the embers. The societies also are engaged fish marketing. The federations are riving for the socio-economic pliftment of coastal fishermen through ese services in the main. Implemention of Integrated Marine Fisheries roject with NCDC assistance was taken during 1996-97 in the coastal districts a total cost of Rs.23.24 crores through oncerned district co-operative fish mareting federations and primary fisheries co-operative societies. The project components included provision of OBM plank built canoes along with gill nets, FRP boats, infrastructure facilities like ice plant-cum-fresh fish storage, godown for salt and dry fish, retail outlets for supply of engine spares and fishing gears, transport vehicles, introduction of acquisition of fish drying racks and insulated boxes. The project included provision of working capital, margin money etc. So far Rs.1099.61 lakhs has been released to the societies for implementation of the project schemes for the socio economic upliftment of the coastal fishermen.

Fisheries Corporation : The Karnataka Fisheries Development Corporation was established during 1971 under the Indian Company's Act, 1956. The authorised share capital is Rs.6.00 crores. The Corporation is engaged in providing facilities like ice production, cold storage, freezing plant, and frozen storage for fishermen and processors, besides marketing of frozen fish through its cold chain. The financial position of the Corporation is however in bad shape presently due to accumulated losses of Rs.5.19 crores. A Committee has been constituted to study the possibilities of improving the working of the Corporation and the report is awaited.

Inland Fisheries Sector

The State has 5.03 lakh ha of inland water resources comprising 2.93 lakh ha of major (6,015 nos) and minor (19,697 nos) tanks, 2.10 lakh ha of reservoirs (73 nos), besides 5813 km length of rivers which provide immense scope for development of inland fisheries. The estimated potential of these resources is around 2.75 lakh t of fish per annum. The present inland production is 1.30 lakh tonnes.

During the period between 1956 and 1966 the foremost activities in the inland sector were to import fish seed, mostly riverine major carp fry collections, from neighbouring States.

Fish seed production and rearing farms have been set up in the government sector with a view to developing the needed infrastructure for producing the required quantities of fish seed for progressively stocking tanks and ponds and reservoirs of the State. At present there are 43 fish seed production and rearing farms under the State Department, zilla panchayats and Fish Farmers Development Agencies. The State requires about 40 crores nos of fish seed to develop all lentic water resources suitable for fish culture. At present there are 81 nos of fish seed production and rearing farms in the private sector and the present total fish seed production capacity in the State is around 233 million fry per annum.

Tank fishery development plays a strategic role in providing employment to rural folk. The fish produced by them provides income too their livelihood or additional incomes to them. The fishery rights of the major tanks with waterspread areas of 10-25 ha vest in Zill Panchayats and fishing rights over major tanks with waterspread area of more than 25 ha vests with the fisheries department. These water bodies are disposed of either by lease or tender cum auction. The fishery rights of minor tanks below 10 hectares are vested in Fish Farmers Development Agencies and Village Panchayats not covered by FFDAs.

Léasing Policy: According to existing leasing policy, fishery rights of tanks are leased in the following order of priority: (i) Karnataka Co-operative Fisheries Federation, Mysore, (ii) Primary Fishermen's Co-operative Societies, iii) Fisheries Co-operative Societies for Women, (iv) SC/ST Fisheries Co-operative Societies, (v) Unemployed fisheries graduates, (vi) Grama Panchayats and (vii) Registered Youth and Women Societies. Revision of the policy is now being considered by the Government.

Reservoir Fisheries Development: There are 73 major, medium and small reservoirs in the State with a total waterspread area of 2.10 lakh ha. Due to fluctuation in water level and because of management deficiencies, the produc-

tivity in the reservoirs is low i.e., 30 kg/ha/annum. It is possible to increase the productivity of reservoirs by optimal sustainable stocking of quality fingerlings or yearlings preferably, and adopting correct management and conservation practices. In the case of most of the reservoirs of the State, unfortunately, pre-impoundment surveys of the rivers concerned before formation had not been carried out. The submerged trees, shrubs etc., have not been cleared affecting fishing operations. Provision of infrastructure by way of construction of fish seed farms, fish handling sheds, ice plants, and transportation vehicles can play a vital role in the integrated development of reservoir fisheries, which offer a great potential for augmenting fish production in the State. Of late, fishery rights of some of the reservoirs are being disposed by tender-cum-auction and in some others through issue of licenses to fishermen for fishing in reservoirs. Steps are under way to link these systems to the production potential and infrastructure facilities provided.

The reservoir fisheries development project with NCDC assistance was implemented in the districts of Mysore, Mandya and Hassan at a total cost of Rs.428.30 lakhs. The project mainly assisted primary fisheries co-operatives for scientific fisheries development of tanks by stocking them with quality fingerlings for augmenting fish production and marketing fish produced through retail outlets. Development of this nature was expected to provide socio economic upliftment of inland fishermen.

Marketing in Co-op Sector: The Karnataka Co-operative Fisheries Federation, Mysore has taken up a programme of marketing of fish produced at reasonable rates from producers and selling them to consumers at a fair price. The federation is procuring fresh fish from Northern Karnataka and selling to consumers through a network of 87 retail outlets in Mysore, Mandya and Bangalore Districts. In these stalls marketing is done through selected unemployed youths, women and entrepreneurs hailing from weaker sections in society in Bangalore, Mandya and Mysore Districts. Primary Co-operative Societies are also being assisted by the federation to take up retail marketing of fish by establishing fish handling sheds and retail outlets. In order to help fisherfolk to sell and transport fish in fresh and hygienic condition, assistance is provided by the federation for purchase of bicycles and insulated boxes with 50% subsidy subject to a maximum limit of Rs.1250.

Integrated Project: It is proposed to take up Integrated Inland Fisheries Development project for implementation at a block cost of Rs.1340.66 lakhs in the districts of Raichur, Bellary, Shimoga, Dharwad, Davangere and Haveri. The project is under consideration of the government for sanction.

Fish Farmers Development Agencies: Under the centrally sponsored scheme on 'Develpoment of Freshwater Aquaculture', 13 Fish Farmers Development Agencies have been established in the State for development of fisheries of ponds, minor tanks and derelict waters. Under this scheme unemployed youth are trained in culture fisheries activities and suitable water bodies are leased to them for fisheries development. The beneficiaries are assisted to obtain loan from the financial institutions for purchase of fish seed, feed, manure and fishery requisites and 25 percent subsidy is provided to them for implementation of components like training, inputs, renovation of ponds and purchase of equipments and fishery requisites.

Utilisation water - logged Areas for Fish Culture : There are an innumerable number of water logged areas in the command areas of irrigation projects which are unfit for raising agricultural crops but having copious water supply. These areas can be developed for fish culture by correcting quality of water and soil. The department has introduced a scheme in 1995-96 for the construction of ponds for fish culture in the water logged areas, providing for a maximum subsidy of Rs.30,000 per acre. So far 158 acres of water logged areas have been developed for fish culture under t scheme.

Private Sector Ponds ~ State Suppor Under Zilla Parishath sector, 25% su sidy to a maximum of Rs.10,000 is pr vided for excavations of ponds for fi culture by farmers in their own lar having water supply facilities.

Inland Fish Production : The inlar fish production during 1994-95 w 70,200 mt. This has increased to 1.2 lakh mt during 2000-01. There is co siderable further scope to increase i land fish production by undertaking o timal sustainable stocking of the su able culture water bodies with quali fingerlings, besides scientific develo ment of fisheries of reservoirs.

Brackishwater Shrimp Farming Karnataka has about 8,000 ha brackishwater area of which 4,200 h are suitable for shrimp culture. Durin 1980s traditional method of shrim farming was practised by the farmers l feeding ponds with tidal waters and clo ing the gates during low tide. Under th system, the juveniles of shrimp a trapped in the pond and are harveste when they have grown upto marketab size. In order to encourage scientif shrimp farming in the place of this tra ping system, two Brackishwater Fi Farmers Development Agencies were e tablished, one at Karwar and another Bramhavar. These agencies are engage in training of farmers in shrimp cultur selection of sites, preparation of proje reports for getting financial assistan from the banks to the beneficiaries.

25% subsidy subject to a maximu of Rs.20,000 per ha and Rs.10,000 su sidy on input cost is provided to t shrimp farmers to encourage scenti shrimp farming. The cost is equa shared by Central and State Gover ments. As a result, by 1994-95 abo 1500 ha of area had been brought und shrimp culture. However, shrimp c ture received a setback during 1996 d to the judgement given by the Supre Court in a public litigation case and a due to outbreak of white spot virus d ease among shrimps under culture.

Salient Fisheries Features of Karnataka

Salient Fisheries Features of Karnataka	
Marine	
1. Exclusive Economic Zone (sqkm)	87,000 sqkm
2. Continental Shelf (sqkm)	27,000 sqkm
3. Length of Coastline (km)	300
4. Total fisher population (nos)	1,99,577
5. Active fisher population (nos)	85,215
6. Fisher villages (nos)	202
7. Fishing harbours (nos)	5
8. Fish Landing Centres (nos)	29
9. Mechanised Boats (nos)	6,821
10. Non-mechanised Boats (nos)	19,088
11. Fishing nets (nos)	38,170
12. Ice plants (nos)	151
13. Cold storages (nos)	40
14. Freezing plants (nos)	22
15. Frozen storages (nos)	20
16. Canning plants (nos)	7
17. Fish meal plants	18
18. Brackishwater Area	8,000
i) Suitable for culture (ha)	4,200
ii) Area developed for culture (ha)	420
iii) Average Production (kg/ha)	818
19. Brackishwater Fish Farmers Dev. Agencies (nos)	2
20. Shrimp hatcheries (nos)	5
21. Fisheries Co-operative Societies (nos)	82
22. Fishery Co-op. Apex Instituions (nos)	2
23. Fish Markets (nos) 158	
Inland	
1. Major tanks (nos)	6.015
2. Minor tanks (nos)	19,697
3. Max.waterspread area of tanks (lakhs/ha)	2.93
4. Reservoirs (nos)	73
5. Waterspread area of reservoirs (lakhs/ha)	2.10
6. Length of rivers (km)	5.813
7. Fish seed production and Rearing Centres	
a) Government (nos)	43
b) Private (nos)	81
8. Fisher population	5.64.465
9. Active fisher population	11.91.132
10. Fish Farmers Development Agencies (nos)	12
11. Fishermen Co-operative Societies (nos)	286
12. Fishermen Co-operative Apex institutions (nos)	1
13. Fishermen training centres (nos)	4
14. Fish markets (nos)	113
15. Aquaria (nos)	13
16. Ice plants (nos)	70
17. Cold storages (nos)	16
18. Frozen storages (nos)	1

As per the directions of Supreme Court, state level and district level aquaculture committees, to consider and recommend applications of shrimp farmers and grant licences to take up improved traditional system of shrimp farming in the ponds already brought under culture prior to the judgement, were brought into being to assist the Aquaculture Authority of India, set up under the court's order, for issuing licenses. So far, 161 farmers in the state have been issued licenses by the Aquaculture Authority. Remaining applications are still under consideration of the Authority. Some of the farmers who have taken up shrimp culture are yet to apply for permission and they are being persuadad to apply for the permission in their own interest.

Link Roads: Other significant developmental programmes initiated in the State include construction of link roads, establishment of infrastructure facilities and setting up cold chain for fish marketing. All the fish landing centres and fishing villages are connected to national highway through link roads. There are 128 such link roads with a total length of 265.19 km all along the coastline of Karnataka of which 20 roads with 34.60 km length are in Dakshina Kannada District, 69 roads with 119.49 km in Udipi District and 79 roads with 111.11 km in Uttara Kannada District, connecting scattered and remote fishing villages to the coastal highway. Due to heavy monsoon conditions these roads get damaged very quickly and require annual repairs and maintenance. For this purpose loan assistance is availed of under Rural Infrastructure Development Fund with NABARD's assistance. So far 26 roads and 5 bridges have been sanctioned by NABARD at a total estimated cost of Rs. 562.63 lakhs. So far an expenditure of Rs.114.63 lakhs has been incurred. Further, it is proposed to take up construction of 21 roads, 6 bridges and 3 fish markets under RIDF-VIII, besides modernisation of 13 fish seed production and rearing farms at a total estimated cost of Rs.1500.00 lakhs. Modernisation of 13 fish seed produc-

tion and rearing farms is proposed to be taken up at an estimated cost of Rs.978.00 lakhs to augment fish seed production of the State.

Housing: With a view to helping houseless fishermen, Matsya Ashrya Scheme is taken up with the loan assistance of HUDCO for construction of 5,000 houses for fisher families at a total cost of Rs.15.00 crores. HUDCO has provided loan assistance of Rs.12.50 crores and remaining Rs.2.50 crores is provided by the State Government. So for 3,284 houses have been completed and remaining houses are in different stages of construction. In addition to the above, the state government has sanctioned 5,000 additional houses at a total cost of Rs.15.00 crores which will be constructed in 2002-03.

Distress Fund: Under the chairmanship of the Minister for Fisheries, Ports and Area Development a Distress Relief Committee was constituted. The Committee has been permitted to raise fund to assist fishermen who are in distress due to natural calamities. A sum of Rs.56.28 lakhs has been collected since inception of the fund and the Committee has sanctioned relief to 1,674 fishermen. A sum of Rs.25,000 has been sanctioned to the families of diseased fishermen.

Saving Scheme: Under CSS Savings-cum-relief scheme introduced to help marine fishermen, Rs.75 per month pe fishermen will be collected for a perio of eight fishing months in a year. Th total amount of Rs.600 thus collecte from each fishermen in a year will b matched with an equal amount by th State and Central governments. This wi be distributed among the beneficiar fishermen during four lean fishin months at the rate of Rs.300 per month

Active participation of the fisher men, fish farmers and all the concerne in the fisheries activities taken up i successive plans is propelling the fish eries sector of the State towards optima utilisation of the resources for enhance production and socio-economi upliftment of fishermen.

NBSAP EAST-COAST ECO-REGION WORKING GROUP

Continued from P.85

2) **Action Plans** : a) Introduction of regulations for fishing; b) permission for limited entry, spatial restriction, mesh size regulation and banning destructive gears; c) improvement of the nursery and breeding grounds; d) afforestation in the mangrove ecosystem; e) minimising pollution, and f) creation of more marine reserves and parks.

Mr. D. Krishnamaiah, Regional Deputy Director of Fisheries, Kakinada, gave an account on regulatory aspects in fisheries sector with reference to conservation of fish. He said that the State of Andhra Pradesh had the unique distinction of holding top position in brackishwater aquaculture and added that it was noteworthy that the fishing holiday from 15 April to 31 May for the entire east coast was successfully implemented with encouraging results. He added that the success of the ban entirely rested upon the coastal fishermen who wholeheartedly supported this effort, realising the necessity for conservation of fisheries. Concluding, he said that the overall goal was to achieve conservation and long-term sustainable use of marine and coastal living resources in a manner that respected the interests of coastal community, whose sole livelihood was sea and sea alone.

Dr. T. Ravishankar, State Project Co-ordinator, M.S. Swaminathan Research Foundation, Kakinada, explained about the Joint Mangrove Forest Management practice through which their organisation could restore 252 ha of degraded mangrove area. Mr. K.Sita Ramaraju, Assistant Director of Fisheries, Kakinada, talked about the subsidy and welfare schemes available for the fisherfolk of Kakinada. Mr. B. Vishnu Bhat, Deputy Director, Marine Products Export Development Authority (MPEDA), Vijayawada, explained the various measures taken by MPEDA to safeguard the mangroves. Dr. K. Phan Prakash, Fisheries Development Officer State Institute of Fisheries Technology Kakinada, spoke about the coasta aquatic pollution and its management Mr. G. Eliah of the Coastal Community Development Programme (CCDP) Machilipatnam, Andhra Pradesh, de scribed the achievements of CCDP in is sue-based activities relating to mangrov ecosystem, aquaculture and social for estry, and in the need-based activitie such as leadership training and incom generation programmes. He also men tioned about the role of women in mar keting, relationship between men an women in the fishing sector and role o women in producing value-added prod ucts. Dr. T. Patanjali Sastry, Environ ment Centre, Rajahmundry, gave a brie account coastal eco-systems, their im portance and need for conservation. H proposed that a shifting forum shoul be organized to facilitate exchange o ideas. He further stressed the need fo bio-resources map of the coast. Mr. N Vara Prasada Rao, State Silviculturis Regional Forest Research Centre Rajahmundry, spoke on the importan measures needed for the protection o forest ecosystem. Mr. B.L. Narasimh Raju, General Secretary, Unite Fishermen's Association, Koringa, Eas Godavari Dt., A.P. spoke on the neces sity for creating awareness among th

Continued at P.11

Sl.No.	Thematic group	Group leader	No. of participants
1.	Estuarine marine and coastal ecosystems	Dr Sastri	25
2.	Resource management	Ms. T.Neeraja	32
3.	Present status of fisheries Acts - problems and remedies	Dr.T.Rajyalakshmi	38
4	Participatory approach	Mr.M.Satya Rao	24

క్వాలిటీ అంటే ఏమిటి?

క్వాలిటీ అంటే ఖచ్చితమైన పనితనము.
ఆశించిన ఫలితాలను అందించేది.

క్వాలిటీ అంటే సురక్షితమైనది.
వాడిన పిదప ఎలాంటి
చెడు ఫలితాలను కలిగించనిది.

క్వాలిటీ అంటే నిర్మాణాత్మకమైనది.
దీర్ఘకాలం ఒకే విధమైన ఫలితాలను అందించేది.

క్వాలిటీ అంటే పారదర్శకత.
ఉపయోగించిన పిదప ప్రత్యేకతను ప్రదర్శించేది.

క్వాలిటీ అంటే అభినందనీయమైనది.
అనుభూతిని పొందే ఫలితాలనందించి
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Demonstration-Cum-Workshop on the Operation of TED

Jaya Residency, Kakinada, A.P.: 26 January 2002

A demonstration on the operation of TED for the benefit of the fishermen was conducted on 24 January 2002 at Kakinada, A.P., by the State Fisheries Department. About 40 fishermen engaged in mechanised trawling from Visakhapatnam, Kakinada, Machilipatnam, Nizampatnam and Nellore watched the demonstration at sea. Scientists from CIFT, CMFRI, State Fisheries Dept (SIFT and FDO), NGOs and faculty members from Andhra University too watched the demonstration.

The operation of the TED was demonstrated from four trawlers (sona boats). The depth of operation was 30 m with towing period of 1.5 hrs; at a speed of 2 knots. The average catch was 26 kg comprising, Barracuda, Nemipterids, Carangids, Anchovies, Shrimp, Mackerel, Mullets, Silver bellies, Puffer fish, Ribbon Fish, Squids, Squilla etc., with an escapement percentage of 1.08.

The workshop which was conducted after the demonstration was held at Hotel Jaya Residency, Kakinada, on 25 January 2002. The Chief guest of the function was Mr.N.Narasimha Rao, Minister for Fisheries and BC Welfare, Government of A.P. The guests of honour were: Mr.V. Venkateswara Rao, M.L.A., Kakinada who presided over the function; Mr.D.Janardhana Rao, Chairperson Z P; Mrs.V.Geeta Viswanadh, M.P; Mr. R.Venkateswara Rao, MLA, Gudivada; Dr. B.C. Choudhary, Nodal Officer, Wild Life Institute of India; Mr.O.Bhavani Sankar, Principal / Addl. Director of Fisheries, A.P. and Mr. C.Ilaiah, Addl. Director of Fisheries, A.P.

Mr. O.Bhavanisankar welcomed the gathering and outlined the purpose of the workshop. The Chief guest of the workshop lighted the lamp. In his Presidential address, Mr. V.Venkateswara Rao, saying that Andhra Pradesh played a significant role in marine fish production advised the fishermen to realise the importance of regulations being implemented by the Department of Fisheries. He exhorted the fishermen to come together and participate effectively in the conservation programme of marine sea turtles by using TED.

C.Ilaiah, Addl. Director of Fisheries delivered the Key Note address on behalf of the Secretary (Fisheries & Animal Husbandry), Hyderabad. He requested the stakeholders to protect, conserve and prevent incidental mortalities of turtles by employing TEDs in trawl nets. This could only be successful by involvement and cooperation of fishermen, NGOs and the related Departments.

B.C.Choudhary said that female turtles came to the shore for laying eggs which took sixty days to hatch. Out of one thousand hatchlings, only one would have the opportunity to complete its first year of existence. To reach the stage of maturity turtle took 25 years. With mortality of 20,000 turtles in India during the season, the situation was quiet alarming, warranting the adoption of all measures to save them. TED developed by CIFT could save the endangered turtles significantly, he added.

D.Janardhana Rao, addressing the gathering said that depletion of natural resources would lead to ecological imbalance. Hence, lending environmental conservation to protect sea turtles was a must.

Later, V.Geeta Viswanath released a Souvenir on "The Operation of the Turtle Excluder Device (TED)".

The Minister for Fisheries, A.P., in his address to the delegates observed that there was no awareness among th people on fishery activities and prote tion of the environment. Pollution the environment would affect the m rine population, particularly fishe prawn and sea turtles. The United State had imposed sanctions on operation trawl nets without fitment of TEDs f protecting turtles so as to conserve then The Minister congratulated CIFT an MPEDA for their efforts in designin TEDs and popularising them. He fu ther stated that during his recent visit Bangkok, he had entered into a proje agreement with NACA for providin training and conducting field demo strations to the Fisheries Department officers of A.P. for achieving sustainab aquaculture in AP. He also said that th Department was taking all possible me sures for the welfare of fishermen suc as: a) Subsidy scheme on diesel; b) A lotment of Rs.10 crores for fisherme housing scheme; c) Setting up thre Residential schools in Krishna, Ea Godavari and Chittoor districts with a outlay of Rs. 3 crores; d) Providing m cro-finance to fisherwomen at Rs.500 - each; e) Extending education loa up to Rs.3 lakhs to fishers to underg Medicine or Engineering course, and Providing common facility centres Rs.10 lakhs each for DFCSs. The Chi Guest later distributed TEDs to selecte fishermen.

A vote of thanks was proposed by M Y.Prakasa Rao, Joint Director of Fis eries (coast), Kakinada.

Technical Sessons

Three technical sessions were held as part of the workshop.

Technical Session I: ***Status of sea turtles in A.P.***

This session was held under th

Continued at P.11

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Status of Fisheries Development in Goa

S.C. Verenkar
Director of Fisheries, Goa
Dayanand Bandodkar Marg, Panaji-Goa.

S.C. Verenkar

Fish has special significance for Goa as it forms a prime item among the main ones in the diet of 95% of its population. Further, fishing is the main source of livelihood of fishermen. With a coastline of 104 km. and around 250 km of inland waterways and 4000 ha of marshy lands along the estuaries, Goa holds a vast potential for development of fisheries. With the commissioning of the Selaulim and Anjunem irrigation projects and around 100 ha of freshwater tanks, the total freshwater resources of Goa now are around 3800 ha.

Fish production in the State increased from 36,616 t in 1970 to 63,440 t in 1999. The details are given in the following Table (Table 1).

Table 1

Year	*Total Fish Production (Tonnes)*	*Growth rate*
1970	36.616	
1980	25.715	-19%
1990	56.225	119%
1995	85.418	52%
1998	70.710	-17%
1999	63.440	-10%

Marine Fisheries

Fishing in Goa covers both Marine and Inland sectors. The State has many major and minor varieties of fishes. The marine catches consist of around 41 varieties of fish species, prominent among which are mackerels and sardines which form almost 46% of the marine catch. The other popular varieties are cat fish, king fish, and pomfret. The exported varieties include shrimps, squids, cuttle fish, breams, ribbon fish etc.

Prior to liberation of Goa, fishing was mainly pursued by traditional methods, mostly by Rampan (Beach - seine) and gill nets. The fishing season used to be restricted to dry season. Most of the catch used to be consumed locally and excess used to be dried for consumption during the monsoon period.

After liberation of Goa from Protugese rule, economic development in the fisheries sector gained momentum in a big way, supported by specific schemes introduced by the government. Over the last twenty years Goa State has experienced rapid mechanisation of fishing crafts initially with the loans advanced and financial assistance provided by the Government in the form of subsidies to fishermen to the tune of 20% on the cost of hull and engine. The consequential rapid mechanisation has resulted in the introduction of over 1,050 fishing vessels with around 500 of these engaged in purse seining and rest in trawling operations. Around 2000 country crafts and canoes are engaged in gill net fishing, exploiting the rich demersal and pelagic resources of the inshore and offshore waters along the coast of the State. Around 25% of the marine production of the State is contributed by the traditional fishermen.

The factors which influence the fish catch are the hydrobiological conditions in the areas known for their fishing grounds. The application of the infrastructure support also has played and continues to play a great role in the development of Fisheries. With the increase in the fishing fleet, opening up of new avenues for export of certain fishes and seafoods and encouragement given by the Government of India to exploit deeper waters, it has become imperative to augment infrastructure and integrated shore facilities like jetties along with ice factories, cold storages side by side with other shore amenities. The Fisheries Department has already provided jetties at Malim, Chaopra, Cutbona, Cortalim and Talpona. Shore amenities like auction sheds, diesel stations, net mending sheds, ice plants and cold storages, workshop facilities, cold storages, parking areas, overhead tank, approach roads etc., are being provided at the main landing centres.

Fishing Harbours

Government had initially provided processing and preservation facilities by establishing cold storage and ice plants at Panaji, Chapora, Canacona etc. The Government is now encouraging the Fisheries Cooperatives for creation of such facilities further by allotment of land and providing financial support by way of subsidies etc.The Government has already allotted land to co-operatives at the major landing centres at Malim and Cutbona. The Vasco landing centre is also being developed as a major fish landing centre with the help of the Mormugao Port Trust.

There was a proposal for construction of a full fledged major fishing harbour in the State. However, considering the topography of the State, it is recommended that minor fishing ports may be developed at convenient places instead of setting up a major harbour.

Marine Fisheries (Traditional)

Around an estimated 20,000 fisher

population have settlements in coastal fishing villages of Goa and those bordering the seven estuaries, various creeks and other tributaries, numbering around 61 covering eight talukas of Goa.

Despite mechanisation since 1964, 25% of the fish and seafood products continue to be contributed by traditional fishermen who have landing centres for their fishing crafts, and for keeping their nets and implements along coastal beaches.

There are around 2000 canoes and country crafts registered in the State. Government is encouraging traditional sector for mechanisation of country crafts by providing financial assistance in the form of subsidy for construction of canoes, outboard motors, gill nets etc. Although the coastline of Pernem, Bardez, Tiswadi, Marmagoa, Salcete and Cancacona are the fishing grounds exploited by traditional fishermen, about 75% of the total fish catch is concentrated only in three talukas, namely Marmagoa, Salcete and Bardez.

The traditional sector, which contributes to a sizeable percentage of the total fish catch, is also supported by Government by providing infrastructure facilities like ramps, auction sheds, net mending sheds etc., for better handling and disposal of their catch, repair of their gears etc.

Freshwater Aquaculture

Freshwater fish farming in Goa, with its around 100 hectares of freshwater tanks and ponds and 3,200 ha. of Anjunem and Selaulim Reservoir waterspread areas, has vast potential. Though the freshwater fish is fast gaining acceptance among Goan population, the preferential choice of the people of Goa continues to be marine fish. Nevertheless a few freshwater fish farmers in the south who culture major carps in their farms have found that freshwater cultural activity is quite remunerative and it can be said that freshfish farming is gaining in popularity in Goa. The freshwater resources available can play an important role in maintaining a sustainable fish supply during the monsoon season. Major carps have been successfully transplanted in the major water bodies of Goa.

A freshwater fish hatchery has already been set up at Anjunem, Kerim Goa where around 15 lakhs of seed of Rohu and Catla were produced during the year 1998-99 and 1999-2000. Besides the reservoirs, smaller water bodies and several irrigation *Bandharas* Mayem lake and smaller perennial and seasonal water bodies, are available. Efforts are being made to popularise major carp fisheries in all available water bodies. Short term training courses in freshwater fish culture are being organised every year.

Goverment is also planning to establish a pilot integrated freshwater fish farm in the State for demonstration and experimentation purposes.

Brackishwater Aquaculture

Out of 18,000 ha. of *Khazan* lands, around 3500 ha. are identified as marshy but suitable for shrimp farming. There is scope for development of ecofriendly shrimp farms and brackishwater fish farms , only through following a cautious approach of observing environmental safeguards.

However, consequent upon the CRZ, Notification of 1991 under Environment (Protection) Act 1986, guidelines of Government of India and restrictions imposed by Apex Court by 1996 judgement, significant portion of Khazan land falling within CRZ area, mangrove land, salt pan lands are banned from conversion to shrimp farming. Further, conversion of lands otherwise fit for Agriculture are also banned from conversion to undertake shrimp farming. These restrictions have led to considerable reduction in the avilability of land for shrimp farming.

A fresh assessment of land suitable for aquaculture is being made. Moreover, around 60% of the marshy area i.e., around 2000 ha is estimated to be fit for aquaculture. At present only around 200 ha of the land is developed for shrimp farming. The Brackishwater Fish Farmers Development Agency looks after brackishwater shrimp farming, identification of beneficiaries, providing technical assistance, market information etc. It also promotes development of brackishwater farming by providing financial assistance in the form of subsidy. The pilot shrimp seed hatchery at Benaulium operated under centrally sponsored project since 1992 under B.F.D.A. is expected to cater to the needs of quality shrimp seed supply to the aquafarmers of Goa.

Traditional Aquaculture Farms

There are a sizeable number of backwater channels meandering the agriculture fields in Khazan lands operated as tide-fed traditional farms. Such tidal farms are primarily storm drains which help in partly providing water moisture for the agriculture lands in Rabi season. These farms are managed by the members of the Tenant Association. There are an estimated of 300 tide-fed fish shrimp farms bordering the rivers in the tidal zones covering an area of around 600 hectares.

Demonstration Cum Training in Shrimp Farming/Freshwater Fish Farming

The Department, in collaboration with the B.F.D.A, has been imparting short term training in shrimp farming as well as freshwater fish farming at the departmental farm, seven ha in extent and at estuarine farm at Ela Dhauji near Old Goa. Upgradation of this farm to propagate eco-freindly aquaculture is also being taken up.

Steps for Development of Fisheries

Development of Fisheries of Goa is important to increase the fish production by utilisation of the available natural resources, and to ameliorate the socio-economic condition of the fishermen who belong to the weaker sections of the society. This can be fully realised only through the upgradation of the occupational training now being imparted

o the fishermen to improve their skills nd efficiency to tap the available re- ources.

With these objectives in mind, vari- us schemes and programmes are being mplemented by the Department to pro- ide necessary infrastructural as well as inancial support. Ever since the Fish- eries Department was established in Goa n 1963, various schemes were intro- duced under the Five Year Plans for the development of infrastructure and for fi- nancial assistance to the fishermen and o improve the productivity. Steps have also been taken towards conservation of fisheries resources and for regulating the fishing activity. Schemes have been in- troduced for the welfare of fishermen. Over the years centrally sponsored schemes were added and implemented. These supplemented the efforts of the State Government in the development of fisheries of the State. The Marine fish production which was around 17,000 mt until 1963, has steadily increased to 85,418 metric tonnes by 1988 itself. This included around 3,200 mt caught form estuaries, creeks and tide fed tra- ditional farms.

Fish Exports From Goa

A good percentage of fish produc- tion in Goa is exported and this has en- abled earning of a sizeable amount of foreign exchange. The exports include frozen shrimps, fishes like Mackerel, Breams, and cephalopods (cuttle fish).

The particulars of exports in 1996 and 2000 are given hereunder :

Table 2

Exported items	*1996*	*Quantity in tonnes 2000*
Frozen shrimps		
Tonnes	1137	85
Value	21.49 crores	2.76 crores
Other fish		
Tonnes	10771	8969
Value	38.54 crores	32.15 crores

There was remarkable increase in the exports during the period 1990-1997 from 4,429 mt to 14,248 mt. The ex- ports, however, came down to a consid- erable extent during the year 1998-99 due to a recession in the fish processing industry and due to imposition of ban by the European Union. The process- ing plants were required to be updated as per the strict standards prescribed. The exports are picking up again now. A notable feature is the export of fish species like threadfin, bream, ribbon fish, seer fish, pomfrets and others like squids, cuttle fish and crabs.

Fisheries Cooperatives in Goa

As early as 1964, the Department of Fisheries, in collaboration with Regis- trar of Cooperative Societies, motivated fishermen to organise themselves into primary fisheries cooperatives. Around ten such societies were formed. How- ever, over the years the major coopera- tives became either dormant or defunct. The only society which continued to function is the Akhil Gomantak Harakari Sahakari Saunsthaq Ltd. which is a society of the fishing stake net op- eratives fishing in rivers and estuaries.

During the last ten years seven more societies have been formed. They are 1) Mandovi Fishermen Marketing Co-op- erative Society, Malim, Betim; 2) The Xapora Boat Owners Fisheries Coopera- tives Society Chapora; 3) The Rio-Sal Co-operative Society, Colva; 4) The Cutbona Fisheries Co-operative Society, Velim,Salcete; 5) The Talpona Fisher- ies Co-operative Society, Canacona; 6) The Zuari Marketing Co-operative So- ciety, Vasco; 7) The Vasco Boat Own- ers' Co-operative Society, Vasco.

Problems And Issues

1.Overmechanisation of fishing crafts: There are around 1100 mechanised fishing vessels in Goa, in addition to esti- mated 2000 traditional motorised crafts. Despite the limited coastline of Goa, there was a frenzy for introducing mechanised fishing vessels with Bank finance in late 1980s and mid-1990s which has led to problems like overfishing, fishing within the prohibited areas, low catches etc. and gave rise to conflicts between traditional and other fishermen, apart from viola- tion of regulations. The Government has, therefore, decided not to allow in- discriminate increase in the size of the fleet and fixed a quota of only five new trawlers of over 14 m LOA per year for introduction as these are considered to be fit to carry out fishing in waters be- yond territorial limits. Construction of smaller trawlers with three cylinder en- gines is totally discouraged.

2. Joint Venture Fishing: The joint venture fishing policy of the Government of India also aggravated the problems of the mechanised fishing boats. The withdrawal of this policy by the Central Government has been a relief to the Mechanised fishing boat Sector.

3. Fishing with Mechanised Boats in Rivers and in Prohibited Areas: Fish- ing with mechanised boats in rivers and the prohibited area upto 5 km. from the coast, fishing during monsoon period etc., have become problematic leading to conflicts with the traditional sector. These activities not only create tensions between the two sectors from the angle of conservation of the resources but also lead to depletion of the resources.

The Government has enacted the Marine Fishing Regulation Act, 1980 and is enforceing the Marine Fishing Regulation Rules 1981 framed there under. The Act aims at regulating fish- ing on a scientific basis and protecting the interests of different sections of per- sons engaged in fishing, particularly those engaged in fishing using tradi- tional crafts.

Following are some of steps taken by the State Government towards solv- ing the problems: 1) Prohibition of fish- ing within an area of 5 km. from the sea coast of the State of Goa throughout the year; 2) Prohibition of catching of juve- niles of fishes such as mackerels, sar- dines etc; 3) Imposing a complete ban on fishing during the monsoon period from 1st June to 31st July; 4) Prohibition of mechanised fishing in inland waters; 5). Regulation of mesh size of fishing nets with meshes over 20 mm used for

catching shrimps and prawns and above 24 mm for nets used for catching fish.

4. Disposal of low value fish:The disposal of low value fish has been one of the problems of fisheries of Goa. There have been complaints of throwing such low value fish in the traditional waters as well as in the rivers thus polluting the waters.

The tendency to throw low value fish in to water is mainly due to the exploitation by the buyers/agents who offer very low prices for such fish. The Government has been considering for a long time about installation of a fish meal plant in the State, which would provide a good avenue for selling low value fish as raw material so as to obtain a reasonable price. But non-availability of suitable site with adequate accessibility, environmental suitbability, and other factors like vicinity of settlement etc., became a hindrance to the proposed project. Suitable sites are being identified taking into consideration the environmental aspects for installation of a fish meal plant in the State.

Value addition to the low value fish is another aspect of consideration. Government is taking all possible steps to encourage the setting up of a fish processing unit for fish sausages, pickle making, canning etc.

5. Monitoring and surveillance: As far as the monitoring aspect for the fisheries management is concerned, the State depends largely on the scientific data available from agencies like CIFNET, NIO., FSI and NRSA etc. The periods and areas of the ban on fishing as implemented under the Marine Fishing Regulation Act are based on such data. The information on availability of resources etc., is disseminated through the extension staff of the Department. The Fishermen's co-operative societies have started playing a significant role in the dissemination of such information. The Fisheries Department has a statistical wing, which collects the information regarding the landings of fish under mechanised as well as traditional sector at the different landing centres through the extension wing.

Prior to liberation of Goa,there was a natural balance and control in fishing operations both in marine as well as estuarine fisheries. In marine operations, those that were traditional were fully stopped fifteen days prior to the onset of the monsoon, as S.W.monsoon winds always set in prior to the actual monsoon which made venturing of country crafts into the sea impossible. Fishing season would always resume with the retreat of the monsoon or on *Narali Pournima* day. No Government control was required to ensure the above.

In the estuarine sector, low lying areas on the banks of estuaries were developed into fishing ponds protected by dykes and sluice gates. These ponds are always contiguous to agricultural land and both coexisted in perfect ecobalance.

The Institution of Communidades, which is a peculiar institution pertaining to Goa, was in overall control of construction, protection of these dykes and sluice gates. With the passage of 'Land to the Tiller' legislation, the responsibility of construction and maintenance of these dykes and gates was passed on to the Tenants Association.

The new land owners saw more profit in fish culture than in agriculture. As a result of this, vast agricultural areas came under use for fish culture. The maintenance of dykes and sluice gates was not,however, proper, thus endangering the entire ecobalance.

The Government has, therefore, to step in to control the damage both in marine and estuarine fishing.

As far as the control of fisheries is concerned, the State is implementing the Marine Fishing Regulation Act and the Marine Fishing Regulation Rules framed thereunder. The Act aims at regulating fishing on scientific basis and protects the interests of different sections of people engaged in fishing.

The main regulations given under the Act are highlighted below:-

1. Prohibition of fishing within an area of 5 km. from the sea coast throughout India.
2. Complete ban on fishing during monsoon period from 1st June to 31st July.
3. Prohibition on catching juvenile fishes.
4. Prohibition of mechanised fishing in inland waters.
5. Restriction of mesh size of fishing nets.
6. Registration and issue of licenses to the fishing vessels.

Future Plans

1) Over the last few years, there have been reports of fish depletion all over the country. In Goa increase in the size of the fishing fleets and overexploitation have been the main reasons leading to the depletion. The Government has taken steps to prepare a Resource Management Plan for sustainable development of fisheries in the State. The Department of Ocean Development has also undertaken to prepare a plan for the Marine Area Management in the State.

2) Utilisation of low value fish has been a major problem in the State. The Government is planning to set up an industrial estate to house the industries related to fisheries activities such as fish meal plants, fish drying platforms, fish processing units for fish sausages, fish pickles, canning etc. so as to provide better opportunities to the prospective entrepreneurs., and

3) For the propagation of freshwater fish culture in the State, Government is taking up the establishment of a Pilot Freshwater Fish Farm in the State.

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Status of Fisheries Development in Maharashtra

M.B.Phadtare
Commissioner of fisheries,
Administrative Bldg., Bandra (East), Mumbai - 400051, Maharashtra

Marine Fisheries Development

Maharashtra has a vast coastline of 20 km. and a continental shelf area of ver 1.11 lakh sq km. The shelf area, ich in fishery resources, offers promis- ng opportunities for augmenting marine ish production.

The EEZ of Maharashtra is endowed ith rich fauna comprising pomfrets, eers, groupers, perches, Bombay- Ducks, mackerels, ribboneels fishes hrimp,etc. which are all exportable arieties. The State contributes to about 5 % of the total marine fish production of the country and it stands fourth in marine fish production among the mari- ime states of the country. The foreign exchange earnings from marine produc- ion in the State has reached a peak of over Rs.750 crores, against national av- erage marine products export earnings of Rs. 4630 crores and of over Rs 6000 crores in 2000-01. Its natural marine capture fisheries resources potential en- riches the economy of the State besides generating employment for the coastal fishermen and other rural communities. There has been a progressive increase in the number of mechanised boats in the co-operative and private sectors of the State. As on today, there are around 29,000 boats including mechanised boats, yielding on an average 35 to 40 t of annual per unit catch. So far 1952 mechanised boats have been constructed in the State with the financial assistance of National Co-operative Development Corporation (NCDC).

The marine fish production trends generally show an increase or decrease by 10% every year, which can be attrib- uted to hydrobiological changes taking place in the sea. However, the produc- tion trends are stable for the last few years. considering that the mechanised boats have a limited operational range. In order to extend operations into far- ther areas for exploiting deep sea fish- ing resources, the State Fisheries Depart- ment has introduced a scheme for "In- troduction of Intermediate Craft". Un- der this scheme, fishing vessels in the LOA range of 16 to 16.5 m, equipped with main engines of higher horse power, gensets and having modern equipment like echo sounder, GPS etc. and provided with walki-talkie sets also are being introduced.

The Government of Maharashtra has been supplying totally sales tax free diesel oil to mechanised fishing boats and also providing to the owning fish- ermen subsidy on fishery requisites by way of "K" forms. During the last fi- nancial year, the financial assistance provided in the form of sales Tax-ex- empted diesel oil amounted to nearly Rs 90 crores. Financial assistance to the tune of about 11 crores on fishery Req- uisites was also extended.

The operational cost on fishing trips has been increasing due to increase in cost of ice, diesel etc. The State has al- ready introduced the programme of dis- semination of information of Potential Fishery Zones (PFZ) in the sea received through satellite. In addition to this, it is now proposed to install electronic fish- ing equipments eg., Echo sounder, GPS, on mechanised fishing boats to facili- tate location of fishing shoals. Walkie talkie sets are also provided for vessel- to-shore and shore-to-vessel communi- cation. These equipments not only help in saving diesel but will also facilitate faster communication which will be helpful in ensuring safety of fishing crew as well as fishing boats. So far, fisher- men have been given financial assistance to instal 788 electronic instruments.

The particulars of annual fish pro- duction in the State are furnished in the following Table.(Table I).

Fresh Water Aquaculture

There are 11,190 irrigation tanks owned by irrigation Department. The fishing rights of these tanks are vested with the Fisheries Department. The to- tal waterspread area of these tanks works out to 3,10,814 ha.

The State Government has intro- duced a new policy for leasing of the tanks, owned by the irrigation Depart- ment. The Government has categorised the tanks under different categories with reference to the waterspread area. As per the new policy the tanks below 200 ha. of water spread area are being leased out to the primary fisheries co-operative societies.

Fresh water prawn farming is a new sector gaining momentum. Farmers in increasing numbers are getting attrtacted to this activity due to high demand for this commodity. At present, about 2600 ha. of water area is under freshwater prawn culture. One constraint faced is the inadequacy of production of hatch- ery produced seed for meeting the present demand in full and the emerg- ing demand.

It is envisaged that during coming years about 3200 ha. of waterspread will be developed for freshwater prawn cul- ture for which about 2 crores of prawn seed is required. Avialbility of natu- rally collected seed in uncertain and the quality is also not dependable. In this situation, considering the need for hatch- ery produced prawn seed a freshwater prawn hatchery has already been set up and it is expected that the production of prawn seed from the hatchery will com- mence from June 2002. The projected

prawn seed production capacity of the said hatchery is 4 crores seed per year.

Development of fisheries of large reservoirs is not within the reach of small fishries co-operative societies. For this purpose, it is necessary to have an integrated approach, consisting of fingerling fish yearling production, supply of fishery requisites, training to the farmers, establishment of ice factory/ cold storage, marketing, extension etc,. Initially four Integrated Reservoir Fisheries Development Projects in Vidharbha region at Akola, Bhandara, Chandrapur and Gadchiroli with the fianancial assistance of N C D C have been taken up and are in operation. In addition to this two more projects are proposed to be taken up in Marathwada region (Nanded and Parbhani Dists.)

Coastal Aquaculture

Maharashtra has about 80,000 ha. of brackishwater area all along the coastline and adjacent to creeks. Out of this, 14,450 ha. of brackishwater area is suitable for shrimp and brackishwater fish culture. Out of these, 10,000 ha of land for shrimp culture and 2388 ha of land for brackishwater culture have already been distributed among 90 beneficiaries.

Coastal Aquaculture has been gaining momentum after the final decision of The Supreme court regulating aquaculture in the CRZ, and the establishment of Aquaculture Authority of India. Also the State level and District level Committees of Aquaculture Authority have been established by the State Government to control coastal aquaculture.

So far, 164 farmers have applied for permission for clearance of their farms by district level authorities, of which 130 applications have been received at state level authority, which has recommended all these applications to Aquaculture Authority. Out of these, 98 applications have been approved by the Aquaculture Authority.

So far, 1163 ha of area have been developed for coastal aquaculture by 77 beneficiaries. Most of these farmers have adopted improved traditional technology as suggested by the Aquaculture Authority where the stocking of shrimp seed is upto 6 nos/m^2 and production is ranging from 750 kg to 1000 kg ha.

New Land Lease Policy

The State Government has released new policy for allotment of Government brackishwater land. In this policy the preference has been given to fishermen/ fishermen co-operative societies. The process of allotment has also been simplified.

The Govt of Maharashtra has reduced the premium and land rent amount for traditional fishermen and fisheries co-operative societies. It is planned to allot the avialable and suitable brackishwater land to the fishermen, individuals and companies within next three years. If the available brackishwater area is brought under shrimp culture, it is expected that about 20,000 tons of shrimp will be produced. This will of farmers and augment incomes of contribute to foreign exchange earnings through export.

Fishermen Welfare Scheme

Some times fishermen face severe problems while engaged in fishing due to natural calamities such as cyclone, storm, rough sea etc. The State Government is implementing the captioned scheme under which assistance is provided to nominees of fishermen in case of death/missing of fishermen while engaged in actual fishing activities in sea, lakes, creeks, rivers, etc. An assistance to the extent of Rs. 50,000 is given by the Government in respect of each of the cases. During the period 1989-90 to 1999-99 the state has provided assitance to the tune of Rs. 181.97 lakhs to 512 fisher families.

Since 1996-97, the centrally sponsored scheme i.e., National Welfare Fund for fishermen is being implemented by the Department, for welfare of poor fishermen of the State. Under this scheme the Government of India has sanctioned 547 houses and 14 tube wells so far. Construction of 146 houses and installation of 7 tube wells has been completed and handed over to the fishermen.

Fishing Harbours

Due to rapid pace of mechanisat progamme, there has been considera increase in marine fish production. cope up with the consequential post-h vest needs, it has become imperative provide landing and berthing facilit along the coast for quick unloading a handling of fish at shore .

At present, there are 184 fish la ing centres including 48 intermedia jetties belonging to the port departm all along the coastline of the state. T fish landing jetties are provided w limited fish handling facilities. Cons ering this,the State Government has ready taken up a crash programme improve facilities at these centres.

The State has three major fishi harbours viz., Sassoon Dock and N Ferry Wharf (Mumbai) and Mirkarwa (Ratnagiri). The construction of 7 n fishing hrabours and 26 jetties is p posed. The estimated construction c of jetties and harbours is about Rs crores. It is proposed to share the c of construction with 50 % State's sha and remaining 50 % as central sha The State Government proposes to ta loan from NABARD to meet its sha In the comming 10 to 15 years it is p posed to construct and develop 40 m jetties with all necessary infrastructu facilities.

Training and Extension

With the rapid progress mechanisation of fishing indust mechanised fishing boats have increas considerably .Consequently the need providing training in operation a maintenance of marine engines, use modern techniques has also increas The State Fisheries Department h therefore introduced additional train courses of six months duration at its training centres in five coastal distri of the State. The centre provides tra ing facilities in the operation of mod fishing gear and in the methods of ma tenance of marine engine & navigat for improving the skills of fisher you

the operation of mechanised boats for wling. Every year 264 fisher youth e trained from these training centres.

Recently the Government of aharashtra has decided to start 10 ort terms training courses on various pics, such as maintenance of marine iesel engines (30 days), Navigation d fishing opertion (30 days), use of odern equipments in marine fishing days), Ornamental fish Aquarium aintenance (5days); Freshwater and rawn brackishwater shrimp farming 5 days each), Composite fish culture 0 days), culture of Lates & Tilapia, (10 ys) and Freshwater fish culture (10 ys). A unique course on maintenance f public aquaria (15 days) has also been ecided to be taken up. These courses ill be organised at district level cenes of the fisheries department.

Tenth Five Year Plan

In the 10th Five Year Plan, greater mphasis will be given on the following programmes.

Inland Fisheries

1. Reservoir fisheries development through proper management practices.
2. Encouraging fishermen to undertake freshwater prawn and seabass farming in order to increase the fish production.
3. Strengthening of inland fish marketing by providing infrastructure facilities.
4. Encouraging private farmers for construction of new fish ponds for employment and providing self employment to them.
5. Renovation, expansion and upgradation of the existing fish seed production farms.
6. Efforts will be made to increase the per hactre production from manageable small ponds so as to improve the economic conditions of rural fish farmers.

Marine Fisheries

1. Improvement of landing facilities at existing jetties and establishment of new marine fishing harbours.
2. Introduction of ship to shore communication facilities by installing two stations at Mumbai & Ratnagiri. Installation of electronic equipments on trawlers.
3. Formation of network of cold chain facilities (ice factories, cold storage, refrigerated vans etc).
4. Encourageing operation of intermediate crafts for deepsea fishing.
5. Safeguarding the interests of traditional fishermen who are engaged in inshore fishing, through effective enforcement of Marine Fishing Regulation Act.
6. Encouraging the adoption of technology of mariculture by traditional fishermen.
7. Making efforts to improve the quality of exportable fishes for better returns of foreign exchange.
8. Encouragement to the processing units for increasing exports.

Brackishwater Fisheries

1. Encouraging traditional and improved traditional fish farming.
2. Construction of shrimp hatcheries in private sector.
3. Allotment of Government land suitable for shrimp farming to the small farmers.
4. Setting up of Brackishwater Aquaculture Estates.
5. Providing assistance for the establishment of shrimp/fish meal plants.

Second Indian Fisheries Science Congress

Indian Society of Fisheries Professionals is organizing the Second Indian Fisheries Science Congress during 23-25 October 2002 at CIAE, Bhopal. The congress will have technical sessions on Marine Fisheries & its Management, Harvest & Post-harvest Technology, Aquaculture Production Technologies, Estuarine Fisheries & CRZ, Fish/Shrimp/Nutrition, Fish/Shrimp Diseases & Health Management, Fish/Shrimp Genetics & Breeding, Fisheries Environment & EIA, Fisheries Education, Training and HRD, Fisheries Extension, Statistics, Economics, Marketing etc. A special Symposium on Enhancement of Fish Production from Indian Reservoirs-An Immediate Priority is also planned to be organised during the congress. Further information can be had from Indian Society of Fisheries Professionals, P.O. Box: 11950, Azad Nagar, Andheri (W) Mumbai - 400 053. Phone: 022-633 2883, Fax 022-636 1573, email: isfp@bom8.vsnl.net.in, mpsk_cife@hotmail.com.

Symposium on Resources and Environmental Monitoring

An International Symposium on Resources and Environmental Monitoring is being organised by International Society for Photogrammetry and Remote Sensing, Technical Commission VII at Hyderabad during 3-6 December 2002. The symposium will focus on the following main topics:

Fundamental Physics and Modelling, Sustainable agriculture and ecosystem approach, Integrated monitoring system for resource management, Human settlement and impact analysis, Disaster monitoring, mitigation and damage assessment. Modelling and monitoring global change. Apart from this, inter-commission sessions on Sensor calibration and testing, Spatial data infrastructure, Global environmental database and internet resources &distance learning will also be held. Two parallel tutorials on sustainable Agriculture and Integrated Coastal Zone Management will be held on December 2, 2002. Further details can be had from Dr. Rangnath Navalgund, President ISPRS TC VII, ISPRS TC VII Symposium Secretariat, National Remote Sensing Agency, Balanagar, Hyderabad - 500 037, Andhra Pradesh, India. Phone: 40 3878962, 3878360; Fax:40-3877210; Email: isprstcvii@nrsa.gov.in; Website: www.commission7.isprs.org.

CIBA - developed Shrimp Immunostimulant - Promising field Results

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Decapod crustaceans are known to evoke non- specific defence responses to counter the influx of foreign particles. They also possess large populations of haemocytes (the blood cells), in their circulatory system, which serve a variety of functions including carbohydrate metabolism, lipoprotein or amino acid transport and storage, wound repair, haemolymph coagulation and defence against invading micro- organisms or parasites (Bauchau, 1980). These haemocytes are to be activated for eliciting the immune response. A variety of cell wall components of fungal and bacterial origin are known to trigger such non-specific responses (Soderhall and Smith, 1986) in crayfish, crab and shrimp. Peptidoglycons, β glucans and lipopolysaccharides (LPS) are successfully used to initiate a series of nonspecific defence activities (Soderhall and Smith, 1986; Person *et al.*, 1987). The fighting abilities of the crustaceans against the invading pathogens depend largely on the blood cells and the plasma (the fluid in which blood cells navigate). The blood cells possess the important enzyme pro-phenoloxidase, while the plasma contains peptides that help in the activation of prophenoloxidase. Activated pro-phenoloxidase sets in a series of biochemical changes that finally help in warding off the threats by the pathogens. Pro-phenoloxidase can be activated only if its release from the cells (exocytose) is accomplished. In the event of an invasion by bacterial or fungal or parasitic agents the haemocytes release pro-phenoloxidase and thus facilitate the activation of pre-phenoloxidase.Gram -negative (Ashida and Yamazaki, 1990) and gram-positive (Soderhall *et al.*, 1990) bacteria were aslo used for activating the pro phenoloxidase (proPO) system in crustaceans (Johnson and Soderhall 1989; Soderhall *et al.*, 1994).

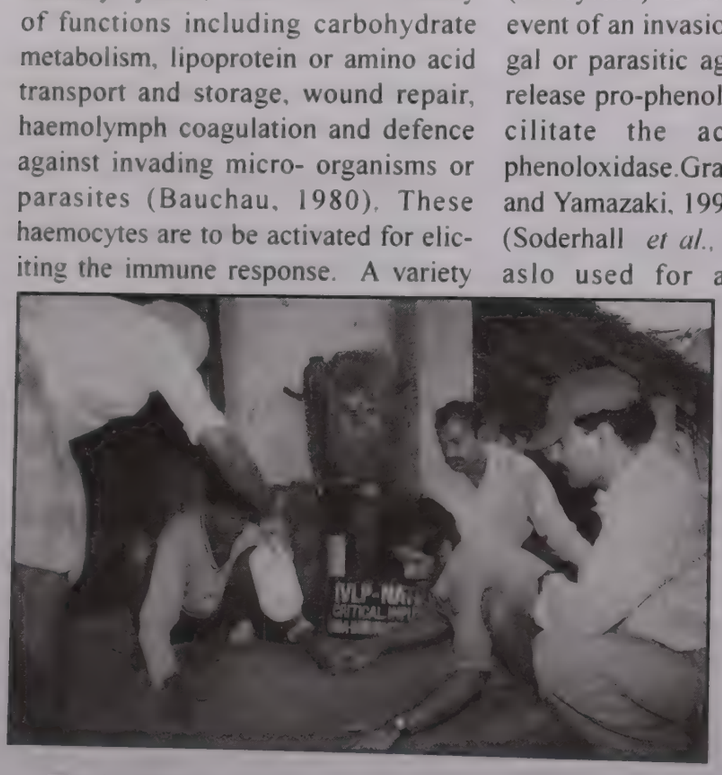

Fig 1: Mixing of immunostimulant with the feed

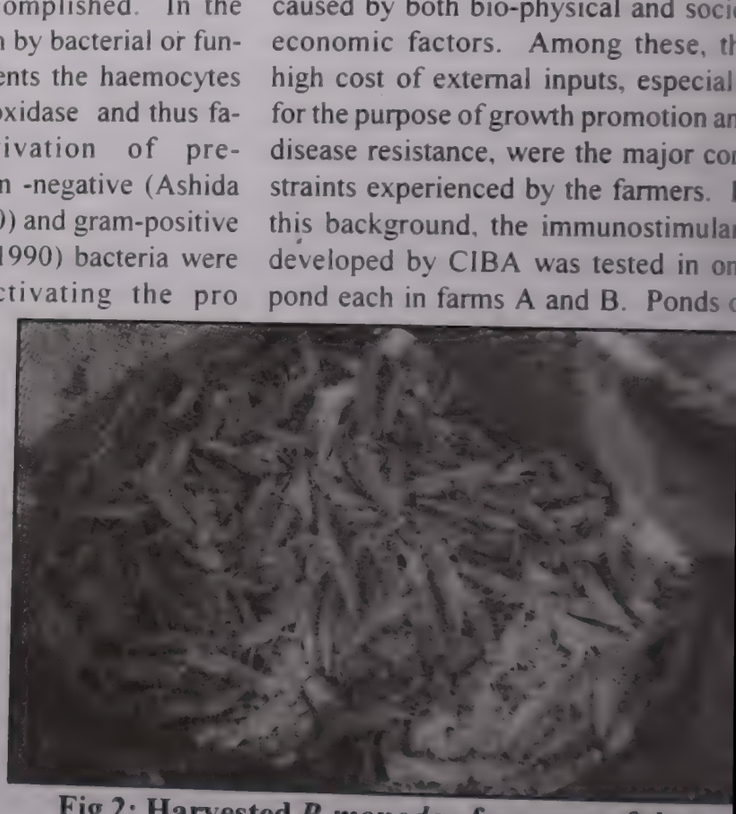

Fig 2: Harvested *P. monodon* from one of the immunostimulated ponds

The Trials

Under the AP Cess Fund project on "Development and Evaluation of Shrimp Immunostimulants using Whole Cell preparations of Vibrio", the Central Institute of Brackishwater Aquaculture (CIBA), Chennai, has developed Vibrio whole cell-based shrimp immunostimulant. Participatory Rural Appraisal (PRA), an exercise that involves active participation of the farmers and end user in analysing and improving the existing production systems, was conducted at Kattur, Minjur Bloc Ponneri Taluk of Thiruvallur Distric about 50 km north of Chennai. The PR exercises revealed that at Kattur the i stability in shrimp production wa caused by both bio-physical and soci economic factors. Among these, th high cost of external inputs, especial for the purpose of growth promotion an disease resistance, were the major co straints experienced by the farmers. this background, the immunostimula developed by CIBA was tested in on pond each in farms A and B. Ponds 1.0 ha waterspread in Farm A and 0. ha in Farm B were selected. The se lected farms are 0.75 km apart with tw feeder canals as the source of intake wa ter. Post larvae of *Penaeus monodo* (PL 20) which were screened and foun negative for the presence of white spo virus (WSV) by polymerase chain reac tion (PCR) were obtained from a hatch ery and stocked at the rate of 6/m² an 12/m², respectively in farms A and B.

Pond Preparation

Ponds were prepared by dewatering sun drying and light tilling of the bot tom soil. Liming, manuring applicatio of cattle dung and fertilization with su

per phosphate and urea were done as routine preparatory operations in both the farms. The intake water was pumped into the chlorination pond where chlorination was done and later the seasoned seawater was pumped in to the culture ponds. The culture operation started in the second week of September 2001 simultaneously in both the farms. One pond each of similar capacity was set aside as control.

Preparation and Application of Immunostimulant

The immunostimulant was prepared using a mixture of inactivated whole cells of *Vibro anguillarum* and *V.alginolyticus*. The cell density in the suspension was so adjusted that through the immunostimulant mixed-feed the individual shrimp received approximately 10^6 cells per dose. The first dose of immunostimulant was given at 15 days of culture (DOC) and the subsequent doses were given at 45, 75, 105 days respectively in Farm A and 30, 45, 60, 75, 90, 105 DOC respectively, in farm B. Number of doses given to different ponds was set, based on the stocking density. The schedule of application of the immunostimulant was 3 day feeding during the adminstration of each dose. The suspension of immunostimulant was mixed throughly with feed (Fig. 1), air dried and fed. Immunostimulant was stored in convenient aliquots for mixing only prior to feeding. The feeding periodicity was 7 times a day in both the farms. The commercial feed, from starter, grower to finisher was used for mixing the immunostimulant. Total culture period lasted 138 days in both control and treated ponds in farm A and in the control pond in farm B. However, the immunostimulated pond in farm B was harvested (Fig. 2) on 132 DOC. The data on growth pattern of the immunostimulated and the control shrimp is given in Table 1.

Table 1 : Growth (g) of immunostimulated (T) and control (C) *Penaeus monodon* in farm A and farm-B

	Farm A			*Farm B*		
Doc	*c(g)*	*T(g)*	*W'goc%*	*c(g)*	*T (g)*	*W'goc%*
15	0.51	0.52	1.96	0.50	0.53	6.00
30	1.33	1.38	3.76	1.20	1.41	17.50
45	7.20	7.62	5.83	6.85	8.44	23.21
60	9.20	9.80	6.52	9.00	10.12	12.44
75	15.25	15.93	4.46	15.00	16.72	11.47
90	22.25	23.50	5.62	22.00	24.85	12.95
105	23	24.92	8.35	23.30	25.70	10.30
120	24.80	26.65	7.46	25.77	29.80	15.64
132	29.20	31.05	6.34	29.85	35.03	17.35
138	31.15	33.09	6.23	31.82	Harvested 132 DOC	Not applicable

DOC: Days of culture: Wgoc: weight gain over control

Table 2 : Production parameters of immunostimulation field trials on *P.mondon* in farms A and B

Parameter	*Farm A*		*Farm B*	
	Control Pond	*Simulated Pond*	*Control Pond*	*Simulated Pond*
Stocking density PL per m^2	6	6	12	12
Size of the pond (ha)	1.0	1.0	0.8	0.4
Number stocked	60.000	60.000	96.000	48.000
Number of doses of stimulation	nil	4	nil	7
Time of harvest (DOC)	138	138	132	138
Average weight at harvest (g)	31.15	33.09	31.82	35.03
Total Production (kg)	1.320	1.450	1.570	854
No. recovered	42.376	43.819	49.345	24.382
Survival(%)	70.63	73.03	51.40	50.80
Production (kg/ha/crop)	1.320	1.450	1.962.5	2.135
Production gain/loss (kg/ha)	0	130	0	172.5
Net gain in revenue excess of control @ Rs. 375/kg	0	487.50	0	64.687.5
Quality of harvested shrimp (% with clear necrotic lesions)	Not Available	Not Available	8.11	0.56

The Observations

During the culture period, fortnightly sampling was done to obtain information on the water quality parameters, general health of the shrimps, feeding rate and the average weight of the shrimps. In 132 days, immunostimulated shrimps in Farms A and B showed steady growth enhancement in comparison to shrimps in control ponds. Immunostimulated shrimp in farm B reached an average weight of 35.03 g on 132 DOC, while those in the control pond reached only 29.85 g. Growth increment of stimulated shrimp in Farm A was lesser compared to that of Farm B because the number of doses of stimulation were fewer in the former case.

The final harvest of the control ponds was carried out on 138 DOC by which time the shrimps reached an average weight of 31.8 and 33.1 g, respectively in Farms A and B. The production details are given in Table 2.

The particulars suggest a possible role of Immunostimulation in reducing infection in shrimp. Difference in the final average weight of the harvested shrimp from the immunostimulated ponds was significantly higher than that of the control ponds. As there was no incidence of any disease during the entire culture period, the survival response

of both the control and the immunostimulated shrimp showed no significant difference between them. In Farm B, a significantly lower percentage of shrimp with blemishes such as those showing necrotic lesions was recorded.

The Feed back

'Seeing is Believing 'and 'Learning by Doing' have been the major responses by the adopted farmers and the fellow shrimp farmers of the locality who visited the trial farms on different occasions during the culture period and also during the harvest. Demand for the immunostimulant has been coming from the shrimp farmers mainly due to the enhanced growth response of immunostimulated shrimps and simple and easy way of application.

CIBA is planning to conduct further field trials during the next crop season on a multi-location trial basis to confirm the highly encouraging results obtained in the preliminary field trials at Kattur village in Tamil Nadu.

Acknowledgements

The authors are highly thankful to previous and present Directors of CIBA, Dr.G.R.M.Rao and Dr.Mathew Abraham respectively,for their valuable guidance, to Dr.S.M.Pillai, Principal Scientist CCD for going through the manuscript critically and to Dr. P. Ravichandran, Principal Scientist in charge, CCD, CIBA for his encouragement all through.

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Fish Workers' agitation from July 25

The National Fish Workers' Forum (NFWF) will start an indefinite agitation by way of a yatra from July 25, 2002 demanding redressal of their grievances.

T.K. Raheman of the NFWF North Coastal A.P unit is reported to have stated that the fish workers' demands included the implementation of Murari Committee recommendations which had been approved by the Central Cabinet on September 27, 1996, adequate supply of fuel at subsidised rate to fishing boat owners,introduction of marine fishing regulation in exclusive economic zone, ban on entry of foreign fishing vessels into Indian EEZ, inclusion of women and inland fishers in saving-cum-relief scheme, withdrawal of Aquaculture Authority Bill, strict implementation of Coastal Regulation Zone rules, entrusting ownership and management of water bodies and fish resources to fishing communities, and imposing a ban on importing fish and cancellation of fishing licenses issued to foreign-owned vessels registered as Indian vessels without justification.

VEHICLE YATRAS: As a prelude to the July agitation, the NFWF is organising 'vehicle yatras' from May 1. On the eastren side, the yatras will begin from Kakdwip in West Bengal on May 1, Visakhapatnam on May 8, Chennai on May 11 and Trivandrum on May 14.

On the Western side, agitation will start from Ummergam in Gujarat on May 1, Versova and Cuffe Parade in Mumbai in Maharashtra on May 3, Goa on May 6, Karwar in Karnataka on May 7 and Calicut in Kerala on May 10. The yatras from West Bengal and Gujarat will culminate at Thiruvananthapuram.

Pre-export Testing of Shrimp for Anti-biotics

Shrimp exports run the risk of detention and withdrawal of the containers if the shrimp are found to contain any trace of antibiotics that are injurious to human health.

The Government of A.P, in collaboration with the Union Commerce Ministry and the MPEDA is reported to have finalised a plan of action to inspect the stocks for the presence of any antibiotics. This plan is stated to be part of a campaign to discourage the use of five specific antibiotics in aquaculture because they have a tendency to stay as residues in shrimps. The European Union has already banned import of shrimp from China. To prevent such a disaster in AP., The State Level Export Promotion Council held a meeting with the representatives of farmers, drug manufactures, sea food processors and exporters on 16 April 2002.

As Andhra Pradesh exported nearly half of Rs.4,000 crore worth of shrimp, mostly cultured ones from the country, the State Government, at the instance of the Union Commerce Ministry, decided on the measures for discouraging use of the anitbiotics.

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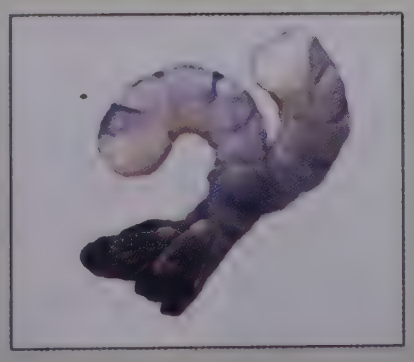

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Workshop on

Responsible Brackishwater Aquaculture

Kakinada, A.P: 8 March 2002

This well-attended workshop was organised by the Society for the Promotion of Integrated Coastal Area Management (SPICAM), Kakinada, Central Institute of Fisheries Education (CIFE), Kakinada centre, Indian Fisheries Association (IFA), Mumbai, and Marine Products Export Development Authority (MPEDA), Vijayawada Centre.

The following were the farmers who participated in the workshop, besides the representatives of governmental organisations etc. : 1) Messers. T. Sesha Reddy, 2) T. Kasi Eswara Rao, 3) D.V.R. Murty, 4) B.A. Ramachandra Murty, 5) B.V.B. Subramanya Sarma, 6) Ravindranadh Raju, 7) G.N. Ravi Kumar, 8) G. Ravi Raju, 9) G. Vinodh Raju, 10) D.S. Reddy, 11) Mattapalli Sanjeeva Rao, 12) M.P.S. Durga Prasad, 13) D.S.V. Subba Raju (Mani Raju) 14) I.P.R. Mohan Raju, 15) S. Krishna Reddy, 16) Y.V. Rao, 17) M. Prasad 18) Ch. V. Surya Rao, 19) K. Srinivasa Reddy, 20) Chanti Babu, 21) K. Raghu, 22) Sreehari Raju, 23) D. Bapi Raju, 24) K.V. Ramanaiah Naidu, 25) P. Venkata Raju, 26) V. Ganga Raju Reddy, 27) Kalyana Chakravarthy, 28) B. Prasad, 29) L. Ramudu, 30) M. Dharma Rao, 31) P.N. Raju, 32) P. Satyanarayana, 33) P. Michcal 34) D. Diwakara Reddy, 35) Ravu Chinna Rao, 36) R. Gopala Rao, 37) R. Rambabu, 38) K. Satyanarayana Reddy

There were two Technical Sessions. Technical session I was presided over by Dr.S.C.Mukherjee with Mr.B.Vishnu Bhat, Deputy Director, MPEDA as Co-chairman. Dr.K.A.Narasimham and Dr.G.Venugopal were the rapporteurs.

Lead presentations were made by the Chief guests. Dr.S.C.Mukherjee spoke on environmental aspects of shrimp culture and diseases of shrimp. Highlight

Fig 1: Dr. S.C. Mukherjee, Joint Director, CIFE, Mumbai, inaugurating the Workshop

Fig 2: Dignitaries on the dais. (L to R) Dr. G. Venugopal, Mr. J.V.H. Dixitulu, Dr. K.R. Prasad, Mr. Satish Chandra, Collector, E.G. Dist., Dr. S.C. Mukherjee, Mr. B. Vishnu Bhat, Dr. T. Rajyalakshmi

Some of the Speakers

Dr. S.C. Mukherjee

Dr. T. Rajya Lakshmi

Mr. B. Vishnu Bhat

Dr. M. Kathrivel

Mr. D.S.V.S. Raju

ing the importance of taking care of environmental aspects as an inherent part of coastal aquaculture, and pointing out that disease and health management had been identified as major constraints in sustainable development of shrimp farming in the country, he emphasised the need for preventing detereoration of pond bottom conditions and sub-optimal environmental conditions leading to secondary bacterial diseases. He spoke extensively on shrimp diseases in India and their impact with particular reference to white spot virus disease.

Dr. T. Rajyalakshmi, Chairman, SPICAM, spoke on the need to develop awareness on responsible aquaculture, particularly by the farmers. Pointing out that there was a noticeable shift from culture operations by owning persons to lease holders, which was not all that desirable, She said that there was now focal attention on environmental sustainability, carrying capacity of a system and responsible aquaculture. She highlighted a couple of outstanding issues that had now emerged with demanding attention and these were a) the need for regulation of aquaculture, b) envisaging a code of conduct for responsible aquaculture and implementing it. While complimenting the farmers for their enterprising approach, she cautioned them against indiscriminate new pond excavations that could harm the environment. It was pointed out the developmental trend should be, by and large, towards 'Food Aquaculture' and not 'Business Aquaculture'. Observing that the use of undesirable antibiotics in farm ponds should be given up by the farmers, she pleaded for rendering R&D administration related to shrimp aqaculture much more supportive than at present and for developing a comprehensive data base in respect of shrimp aquaculture, promotion of quality shrimp feed manufacture indigenously, promotion of social awarness towards shrimp culture, avoidance of overfertilisation or ovrfeeding, and promotion of genetic research related to shrimp. Pleading for protection to small farmers from threats of pollution from new industrial developments, she emphasised the need for coordinated application of responsibility by the government concerned, village communities, the farmers and pollution causing industries.

Mr. J.V.H. Dixitulu, Editor, *Fishing Chimes*, made a presentation on dimensions of responsible brackishwater aquaculture. Emphasising the need for precision farming and pointing out the problems of responsible aquaculture, he had put forth a proposal for the setting up of Brackishwater Aquaculture Promotion Agencies, one for each of the coastal States which could be made nodal for a) convergence of technological and other useful information from the Union Fisheries Division, concerned Central Fisheries Research Institutes, MPEDA, Coastal State Fisheries Departments and others, for transimission of the same in suitable form to the farmers by telephone or through email/fax. He suggested that each of the farmers should be equipped by MPEDA with computer/fax facilities for conveying information related to farm conditions on a daily basis to the Agency concerned. While some of the farmers would have to be helped in using the gadgets initially, over a period of time, they would pick up the usage, as it would be useful to them also, he added. Another suggestion made was that the Agencies may be registered under Society's Act and the Regional Aquaculture Centres of MPEDA may be merged with the Agencies. The Agencies may have Management Committees with the officer-in-charge of the merged Regional aqua centres as one of the members and the Secretary of the Committee and with the members and chairman appointed by MPEDA. It was suggested that MPEDA's Units may be merged with the proposed Agencies along with the annual bedget. He had dealt with certain technological reforms such as pondlining, development of domesticated broodstock, polyculture of shrimps with Tilapia, introduction of 'pond cage culture system, closed circulation systems etc. The need for the Proposed Agency to organise financial assistance to the farmers was also emphasised.

Dr.P.S.B.R.James, Director, CMFRI (Retired) spoke on the need for stabilisation of shrimp aquaculture and propagation of sea farming. He suggested that the accent on coastal shrimp culture to be slowed down and the activity shifted to pen and cage culture of shrimp in the sea and scampi culture in the abandoned shrimp culture ponds and elsewhere.

' Mr.Prakas Rao, Joint Director of Fisheries, A.P, read a paper entitled 'Responsible brackishwater culture' which was to be presented by Mr. D.S.Murthy, Commissioner of Fisheries, A.P. Some of the main points made related to the need for setting up pond effluent system, setting up of aquaclubs, encouraging Cooperative farming etc. Reference was made to the proposed legislation on Aquaculture Seed (Quality Control).

Dr.K.R.Prasad, President, Confederation of Indian Aquaculture Welfare Associations, spoke on the need for improving the farming practices for contributing national economic development and augmenting production and exports. Explaining the role of the Confederation of which he was the president, he said that the organisation strove to promote scientific management practices to achieve higher productivity. It also served as a collective voice of the farmers in interacting with policy makers in respect of securing appropriate support to the aquaculture industry. He added that the Confederation had no restriction on membership and no fee was collected and said that service was rendered free.

B.Vishnu Bhat made a presentation ' On critical issues facing shrimp aquaculture and possible solutions'. Recounting the various problems faced such as inadequate supply of quality seed, difficulties in securing adequate finance and insurance coverage, inadequate R&D effort, lack of extension services, absence of co-operation among farmers, non-availability of qaulity water for culture, and environmental problems, he suggested certain solutions such as institution of extension programmes for con-

trol of disease outbreaks, availing of opportunities provided under MPEDA-NACA technical assistance programme on control of shrimp disease and on having coastal management programme, following a code of practices for hatcheries for ensuring supply of quality-seed, management of pond bottom sediment and waste water discharge, planting of mangroves in the vicinity of shrimp farms, ensuring quality of cultured shrimp, avoidance of using banned drugs in any form, development of area-wise master plans, etc. It was mentioned that the Member Committee of EU would be visiting India soon for examining the working of processing plants. It was added that the Committee, in its earlier visit, was not satisfied with the working pattern of some of the processing plants visited.

Mr. O. Bhavanishankar, Principal, State Institute of Fisheries Technology, Kakinada, spoke on the role of state fisheries department in promoting responsible brackishwater aquaculture. He outlined the strategies adopted for promoting effective health management techniques for ensuring disease free and well grown shrimp crops, and the demonstration efforts being put forth by the department in this direction, propogation of the concept of alternative species culture, and formation of aquaclubs. He had also explained the salient features of the Aquaculture Seed Bill proposed for enactment by the Fisheries Department.

Dr.M.Kathrivel, Scientist, CIBA, spoke on 'Guidelines for mud crab fattening and Grow-out culture. These covered aspects such as pond preparation, in respect of both fattening ponds and grow-out ponds and also in respect of stocking, feeding, and monitoring of reared stock, and harvesting and marketing related to both the categories of culture endeavour.

Dr.K.A. Narasimham, vice-president, SPICAM, made a presentation on 'Use of Bivalves and Seaweeds in treating the shrimp pond waste water'. Explaining the use of bivalves and seaweeds in developing an eco-friendly shrimp culture, he emphasised that an integrated farming system involving bivalves and seaweeds with shrimp culture needed prior attention for the development of sustainable brackishwater aquaculture. Explaining the use of bivalves and seaweeds in developing an eco-friendly shrimp culture, he emphasised that an integrated farming system involving bivalves and seaweeds with shrimp culture needed prior attention for the development of sustainable brackishwater aquaculture

DR.T.Arasu, Principal Scientist, CIBA, made a very impressive presentation on 'Asian sea bass, *Lates Calcarifer*' - An Alternative candidate species for sustainable aquaculture. Pointing out that *Lates calcarifer* constituted an important candidate species suitable for farming in ponds and cages in fresh and saline water eco-systems, he explained the technology developed at CIBA for sea bass seed production in the hatchery: The presentation covered bionomics of sea bass, its broodstock development, fish collection and transportation, their acctimatisation, broodstock holding facilities needed, and their maintenance, water quality management, management of feeding and health management maturation and spawning, induced spawning of broodstock, egg collection and incubation, larval rearing, nursery rearing of the fry and culture of the species. His concluding comment was that it might not be possible for the farmers to secure profits out of seabass culture, same way as they presently got out of shrimp culture.

Dr. S.C. Mukherjee, Chairman of the Session summarised the various presentations.

Technical session II was devoted to interaction among farmers, industry and experts. Mr.Satish Chandra, Collector, East Godavari district participated in the session.

In reply to a query and elaborating on the forthcoming visit of EU delegation, B. Vishnu Bhat said that EU was scared of the excessive use of antibiotics in shrimp culture. While use of certain antibiotics was banned, there was a later agreement on regular monitoring of quality of pond waters. 300-400 samples were collected from AP farms and sent to Cochin and the results of analysis of the samples were furnished to EU. As a follow-up, EU Team was now coming for a further study of pond water quality. He said pamphlets were distributed among farmers on banned anti-biotic items. Reacting to another question on insurance of shrimps under culture, Vishnu Bhat said that the facility was there but the premium was very high (3% on east coast and 2% on the west coast). He added that insurance companies were not willing to reduce the premium rate but they might be able to consider reduction in the case of total loss. A point was raised about banning of import of certain chemicals which were misused by way of mixing with the feed. In reply, it was mentioned that MPEDA gave guidelines on culture within CRZ and outside CRZ which included advice on the non-application of anti-biotics. Adding that samples of feed and pond waters were already sent for analysis, a suggestion was made that there should be a regulation that aqua drugs should not be sold without authorisation from MPEDA. It was mentioned that even now sale of undesirable drugs could be controlled by Drug Inspector concerned. The Collector said that a list of harmful drugs could be given to him for advising the Drug Inspector concerned appropriately.

There was a complaint that shrimp hatcheries were selling seed at PL 13 stage itself so as to economise on the use of artemia. It was promised by Deputy Director, MPEDA, Vijayawada to look into this aspect. Quality of feed available in the market was discussed for appropriate further action.

There was a plenary session under the chairmanship of Mr. J.V.H. Dixitulu at which recommendations were finalised and approved by the participants. The recommendations were as follows.

Recommendations

Having deliberated at length on the

various organisational as well as the field problems confronting the brackishwater aqua farmers, particularly in respect of production of healthy, disease-free and sustainable tiger shrimp crops in an environment-friendly manner;

Noting that the farmers, while devoted to their profession, are still in the learning curve and that a well structured organisational mechanism is needed to channelise their efforts towards achieving optimal production;

Convinced in this context about the inescapable need to have coastal State-wise exclusive and dedicated Agencies for the promotion of responsible brackishwater culture supported by an interlinked pervasive field service set-up that would penetrate particularly into the clusters of brackishwater farms, in a way that it would replace the multiple and disorganised set-up dominated by consultants that now serves the farmers with conflicting and amateur advice, leaving most of the farmers a disillusioned and confused lot;

Concerned over the absence of an accesible mechanism for extending needed redeemable financial help by way of loans to the farmers for strengthening brackishwater culture on a sound and remunerative basis;

Cognisant of the crucial importance of developing domesticated tiger shrimp broodstock so as to extricate shrimp hatcheries form the present risky and pernicious dependence on wild brooders, and consequential problems faced by the owners in supplying disease-free PLs to farmers at remunerative prices;

Aware of the imperative necessity of promoting polyculture of shrimps with finfish including Tilapia in ponds and also by way of pond cage culture;

Conscious of the economic benefits farmers of South-east Asian countries such as China, Thailand, Vietnam etc., have been enjoying through eco-friendly culture of shrimp with Nile/GIFT Tilapia/ Sea bass and others, based on production of all-male Tilapia offspring;

Concerned over the declining per unit culture of shrimp production in the CRZ, even under environmentally safe conditions, because of economic constraints faced by the farmers for raising the output;

Alarmed at the trend of farmers adopting untested and harmful culture procedures unintentionally misled by some and expressing anxiety over the absence of well-oriented farmer training programmes;

Disillusioned at the unregulated and unethical manner in which drugs and chemicals for maintaining water quality and for disease control and cure are sold to the farmers; and

Noting that in several countries shrimp culture in lined ponds and adopting recirculation and other eco-friendly systems that yield optimal sustainable production and profits are being encouraged, but have not yet been introduced in the country;

The Seminar made the following recommendations.

1) MPEDA may set up coastal State-wise Brackishwater Aquaculture Promotion Agencies (BAPA). These may be essentially in the nature of organisations for the farmers, of the farmers and by the farmers. The Agencies should be designed as centres for the convergence and dissemination of all technological and other information of interest among the farmers. MPEDA may consider merging its Regional Aqua Units with the suggested State Agencies concerned along with the budget and technologically competent staff as required, nominating the officer-in-charge of the Regional Aqua Unit concerned to function as the Chief Executive of the Agency. It may also be provided for the farmers to contribute an annual fees as decided to strengthen the finances of the suggested agency. A concomitant well-staffed integrated field-set up that would effectively penetrate particularly into the farm clusters in a technologically effective manner may be organised. MPEDA may set up a Management Committee for each of the Agencies, with a strength to be decided upon by it and with half of the members drawn from progressive brackishwater farmers, and the remaining half from the various related organisations, and with one out of them (officer-in-charge of the related Regional Centre, Aqua), MPEDA, to be the Chief Executive and to function as the Secretary of the Committee. MPEDA may nominate an addittional official or a non-official member of its choice to be the Chairman of the said Management Committee. The Agencies may be registered by MPEDA under the Registration of Societies Act. As soon as the Agencies are set up, they may help each of the farms to equip itself with fax, computer (email) facility in an appropriate manner. A system of transmission of preferably daily information related to bio-security i.e., pond water parameters, stocking, care of the crop including problems of disease incidence, quality of inputs including drugs, chemicals etc., by each of the farms to the Agency concerned by fax/email, in a proforma to be prescribed, may be introduced so as to facilitate farm-centred monitoring by it and ensuring responsible brackishwater culture at all stages, instead of facing situations of farm conditions suddenly deteriorating leading to mortality. The Agency may institute such other measures as are necessary to strengthen the system, particularly for eliminating undesirable intervention by unauthorised consultants etc.

2) NABARD may recognise the said Agencies as units for financing brackishwater farmers. It may evolve measures or a system to entrust to the Agencies the function of extending loans to the farmers with NABARD's refinance under a guarantee from MPEDA, in the same way as NABARD now extends refinance through co-operative and other commercial banks. MPEDA may take up this issue with NABARD, considering the present plight of the farmers in securing loans.

3) The domesticated shrimp broodstock development project already taken up by CMFRI may be further strengthened with a selective breeding

component and needed financial inputs for acheiving quicker results and for progressively diminishing and ultimately extinguishing the present dependence by the hatcheries on wild stock for securing brooders, by way of replacement with selectively bred domesticated shrimp brooders. Considering the importance of the project in making disease-free PLs of shrimp available to the farmers, intervention by MPEDA in the strengtherning of this project financially is essential.

4) Considering that NILE/GIFT Tilapia being not so prolific a breeder and widely cultured by various sout-east Asian countries without any reported adverse impact on their respective ecosystems, MPEDA may form a group of specialists to undertake a study of the scope for polyculture of shrimp with Tilapia and other species such as seabass, stated to have been undertaken profitably because of the export enhancement dimensions in countries such as Thailand, Vietnam, Taiwan, etc., and recommend a plan of action for the promotion of polyculture of Tilapia with shrimp and also under pond cage culture system as introduced by Team Corporation of Taiwan with considerable success, linked to a system of protected production of mono-sex Tilapia seed at selected farms in the each of the coastal states for release to farmers for stocking purposes.

5) MPEDA may take the initiative of bringing to the notice of the Supreme Court the alarming drop in per ha production of shrimps in CRZ and falling incomes of farmers because of compulsive adoption of traditional extensive and modified extensive culture systems and also about the availability of proven improved systems which are known to safeguard environmental conditions and at the same time augment production (as experienced in other countries such as Vietnam etc..) and in that light seek approval of the court for undertaking experiments based on a well drawn project, in three selected farms in the CRZ, involving pond lining, addition of substrates, recirculation of water etc., and with practically no water exchange and adopting responsible levels of stocking for reaping sustainable harvest without in any way impacting on the environment. It can be suggested that such an experiment may be supervised and monitored by the Aquaculture Authority of India. MPEDA may present a Project Report drawn up on these lines to the Supreme Court for such direction as the court deems fit. The seminar felt that this approach is of paramount urgency to provide relief to the farmers majority of whom are poor and who are often sustaining losses.

6) A Farmers Training Centre with an attached dedicated shrimp farm may be established or identified out of the existing ones by MPEDA in each of the coastal states for imparting field-based practical training for one complete culture cycle to the farmers in batches.

7) Duly approved and quarantined drugs and chemicals alone may be permitted to be imported for application in shrimp farms. Field offices of the Drug Control Department may be strengthened to enable prior inspection of the drugs and chemicals used in aquaculture before sale at the various wholesale and retail outlets. A system of preventing sale of unauthorised drugs may be evolved and enforced.

8) The present R & D effort needs to be stepped up to meet the critical challenges posed by disease recurrence in the farming and hatchery sector.

9) It is recommended that farm clusters along coastal stretches of 1-5 km may be identified to undertake efficient effluent water management. It is further recommended that effluent farm water channelising and treatment system, to serve the related clusters, may be developed so as to ensure release of clean water from the farms into the environment. Like-wise a system of supplying filtered clean brackishwater to the farms in the clusters may be developed.

10) Brackishwater aquaculture may be expanded into new areas but confined to specifically identified areas so as to ensure environmental safety and such areas should be reserved for the benefit of registered farmers only. 'Limited Entry' principle must be followed to limit further expansion in unfavourable areas.

11) Consultancy services by unauthorised persons should be banned.

12) Farmers should be made to strictly follow PCR tests before stocking shrimp PLs in their ponds. They should be also encouraged to plant mangroves around shrimp ponds.

13) Integrated aquaculture should be encouraged as also nutrient recycling through use of suitable species of sea weeds and molluscs, as proposed by Dr. Barelach, over three decades ago.

14) Aquaculture Authority of India within CRZ and State Departments of Fisheries outside CRZ should come forward to issue licenses for undertaking shrimp culture on the basis of selected norms.

15) A trained cadre of manpower to popularise technological advances in shrimp culture may be developed by the concerned institutions.

16) Further excavations along river banks, mangrove beds, river islands etc. for shrimp culture may be banned.

17) A regulation may be introduced for feed industry to stencil appropriate and authorised marks indicating of quality of the packed feed. A quarantine system for imported drugs, feed ingredients etc., may be introduced.

18) Aquaculture Authority of India may expedite clearance of pending applications seeking licenses for the farms in CRZ.

19) A white paper on breckishwater aquaculture in India may be prepared by MPEDA for the benefit of the industry and planners.

Dutch Collaboratory Research Projects for Improving Sustainability and Productivity of Pokkali-based Shrimp Farming in Kerala

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B. Madhusoodana Kurup

The Netherlands University Foundation for International co-operation (Nuffic) cleared two research projects for implementation by the Cochin University of Science & Technology.The projects were formulated with a view to improving aquaculture production,its sustainability and for containment of shrimp disease in the Pokkali fields of Kerala. These projects were sanctioned as part of the ongoing Dutch Govt. assisted MHO programme being implemented at Cochin University of Science & Technology. The two projects were identified to address the contemporary and confronting issues of coastal aquaculture production and its sustenance in the country in general and shrimp farming in Pokkali fields in Kerala in particular.These will be implemented by the Centre for Coastal Zone Management (C-IMCOZ) at the School of Marine Sciences. Wagenengen University. Netherlands is the Dutch collaborating Institute with Dr.Marc C.J.Verdegem as the Dutch counterpart whereas Prof.(Dr.) B.Madhusoodana Kurup of School of Industrial Fisheries is the counterpart from CUSAT.

The sustainability of the shrimp farming in Pokkali fields of Kerala is facing severe threat on account of deterioration of soil and water quality of Pokkali fields. Degradation of estuarine ecosystem is observed to take place due to indiscriminate discharge of effluents from the shrimp farms characterised by high nutrients, suspended organic materials, and crop failures. Losses take place due to poor environmental conditions in the ponds and its vicinity, and recurrence of viral disease among shrimps due to stress and strain caused by adverse environmental factors.Most of these issues are centered around the supplementary feeding of shrimps under culture with high protein feeds and the consequent unconsumed feed accumulation as waste at the pond bottom which is around 50% of the total feed used for feeding in a pond. The waste so accumulated coupled with faeces from the cultured stock and dead organisms undergo decomposition, which results in the oxygen deficiency and exposure of the shrimp to toxic chemical forms like Ammonia, Nitrite, Hydrogen sulphide, etc., generated as a consequence. All these activities will ultimately result in the developement of anaerobic condition and contribute to the increased production of Total Ammonia Nitrogen (TAN) in the culture pond. The exposure of shrimps to such conditions can cause severe stress and strain leading to mortality.

The first project entitled 'Improved sustainability of shrimp farming in the Pokkali fields of Kerala through control of carbon /nitrogen ratio in the pond' is sanctioned by Nuffic for the development of a technology to reconvert the waste feed (which gets accumulated at the pond bottom) as microbial protein. The technology will be based on optimisation of C:N ratio in the pond together with providing additional Carbon source which would enhance *in situ* proliferation of heterotrophic bacteria. The dual advantages of this technology are (1) reconversion of the protein left as waste at the pond bottom as microbial protein and its use as feed by the shrimp (2) reduction in the inorganic nitrogen accumulation in the pond bottom and effluents which would in turn improve the health status of the shrimp. Reduction in the wastage of protein in the shrimp feed is another added advantage which is having a strong bearing in the reduction of feed cost as well and in turn making the shrimp farming more economically viable. This technique will also minimise the nutrient levels in the pond effluent discharges and thus making farming more eco-friendly. This study assumes significance in the wake of rampant recurrence of virus disease outbreak reported now a days in the Pokkali fields of Kerala which have been registering crop losses in the range 80-100% in spite of applying so many management measures to combat disease incidence.

The second project entitled 'Improved coastal aquaculture production and sustainability in Kerala through the introduction of crop rotation is aimed at introducing crop rotation between giant freshwater prawn (Scampi) and Tiger shrimp on a rotational basis in the Pokkali fields with a view to improving aquaculture production and sustainability. Now a days the farmers have been gradually abandoning rice culture in the Pokkali fields due to the diminishing returns and this trend keeps these fields almost fallow for a period of 6-8 months. Economic and environmental auditing on four types of utilisation of Pokkali fields will be made under this project. One type is that traditional paddy culture will be followed by shrimp farming. Another will be taking one crop of shrimp alone. The third type would be that, one crop of rice together with prawn would be followed by shrimp and the fourth pattern would be one crop of scampi would be followed by a crop of

shrimp. Economic data generated from these different combinations would be studied and conclusion drawn while environmental auditing would be based on high nutrient harvest and low nutrient discharge and sustainability from the point of nutrient discharge and accumulation.

The study will be based on the Pokkali fields of Ernakulam district under the joint technical know how of WU and CUSAT with a total financial outlay of Rs.18 lakhs.

As part of these two projects, some incentive packages are also available for those enterprising farmers who are interested to associate with these projects. Farmers who are interested to associate with the project themselves can contact the Indian counterpart for getting more details of the project.

NBSAP EAST-COAST ECO-REGION WORKING GROUP

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fisherfolk on government orders, acts, rules etc. Mrs. V. Damayanthi, representing Women Fisherfolk, Kakinada, also expressed her concern about need for creation of awareness among fisherfolk especially women for conservation of marine bio-resources.

After these presentations, four thematic groups were formed. These were as follows:

These thematic groups discussed at length the various issues relating to their themes in the context of NBSAP preparation. After the discussion, the group leaders presented the views of their groups.

The workshop was concluded with a vote of thanks, proposed by Dr. A. V. Raman, Professor, Andhra University, who summarised all the events of the workshop and thanked all those responsible for initiating the NBSAP process and those helped to organise the workshop.

Recommendations of the Groups

Coastal Zone Management : 1) Coastal ecosystems should be viewed as a single unit; 2) Industrial, agricultural and urban activities in the catchment areas should be closely monitored; 3) Industries along coasts should be set up only after proper Environmental Impact Assessment (EIA) studies; 4) Erosion in the Godavari, Krishna and central delta areas, farm lands, habitations, etc. and prevention of erosion due to natural calamities should be studied; 5) Introduction of selective mangrove species along the coastal belt should be thought of to prevent erosion; 6) Littoral drift in the coastline should be addressed to, and 7) Culture industries should allocate certain portions of their profit for research and development activities.

Coastal Monitoring Process : 1) It will be desirable to identify certain hotspots where biodiversity is under severe threat in coastal areas; 2) Monitoring the coast using Remote Sensing and Geographic Information System techniques can be attempted; 3) Database of coastal zone management should be upgraded; 4) For treatment of aquaculture effluent, biofilters like bivalves and seaweeds can be used, and 5) Biological control of pesticides is to be encouraged.

Mangrove Conservation : 1) Updating of list of mangrove and allied flora and fauna according to spatial and temporal variations; 2) Identification of degraded mangrove area for regeneration, and 3) Community based participatory afforestation activity to be extended to mangrove ecosystem and adjoining areas.

Marine Bioresources Conservation: 1) Study on genetic biodiversity is needed to create genetic pool; 2) Catalogue of marine flora and fauna (viz., microorganisms, algae, seaweeds, vertebrates, invertebrates etc.) of a region is essential; 3) Germplasm preservation Centres to be set up by the national agencies; 4) Effect of trawling on bottom biota (eg., vanishing stocks of pearl oyster and chunk beds) to be studied, and 5) Wild species can be used for culture practices after standardizing the captive breeding procedure and nursery production of seeds in order to prevent dependence on wild resources.

Fisheries Management : 1) Over exploitation of fishery resources has to be addressed in terms of providing with alternate employment and enforcing the regulations in fishing, ban on collection of prawn seeds, broodstock and marine regulation act; 2) Dispute between fisheries department and fisherfolk in collection of shellfish has to be settled; 3) Awareness to fisherfolk on the importance of fisheries resources and the need for their conservation should be created; 4) Fishermen can be educated for catching targeted species such as sharks and chunks; 5) Rehabilitation of fishermen who make their livelihood by exclusively collecting ornamental molluscs, sea-cucumbers etc., which are listed in Annexure - I of the MoEn & F notification dt. 21 September 2001 is needed; 6) Deep sea fishing is to be encouraged; 7) Closed season for fishing is recommended; 8) Ban on wild broodstock collection can be there; 9) Sea ranching is essential; 10) Mesh- size regulation is necessary in fishing, and 11) Strict scrutiny of ship breaking units is essential.

Community based Marine Biodiversity Conservation : 1) All Bills are to be placed on statute book and implemented, adopting stake-holder approach with people's participation; 2) Understanding and co-operation between the people and the Government are needed to take concrete steps for marine biodiversity conservation; 3) Awareness can be created on the disasters and their hazardous effects on the marine environment; 4) Improvement in quality of in people's participation can be made through discussions, meetings, workshops and seminars; 5) Improved efforts can be made to find avenues for people's alternative livelihood, in order to reduce pressure on the natural resources, and 6) Environmental protection measures can be taken up with the help of local communities and public.

Others : 1) Farmers' rights are to be protected; 2) Exemption of sales tax and central excise duty on diesel mechanical crafts is required, and 3) Participatory approach is needed for biodiversity conservation.

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String Shells Technique for Effective Harvesting of the Post Larvae of Indian River Prawn under Hatchery Conditions

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A new String Shells technique, adopting stringed freshwater mussel shells for harvesting post - larvae of Indian River Prawn *Macrobrachium malcolmsonii* and *Macribrachium gangeticum* was developed by the authors. This was found to save time and labour and reduce post larval mortality. The application of the technique threw light on the post larval metamorphosis, which will help in further improving the new technique.

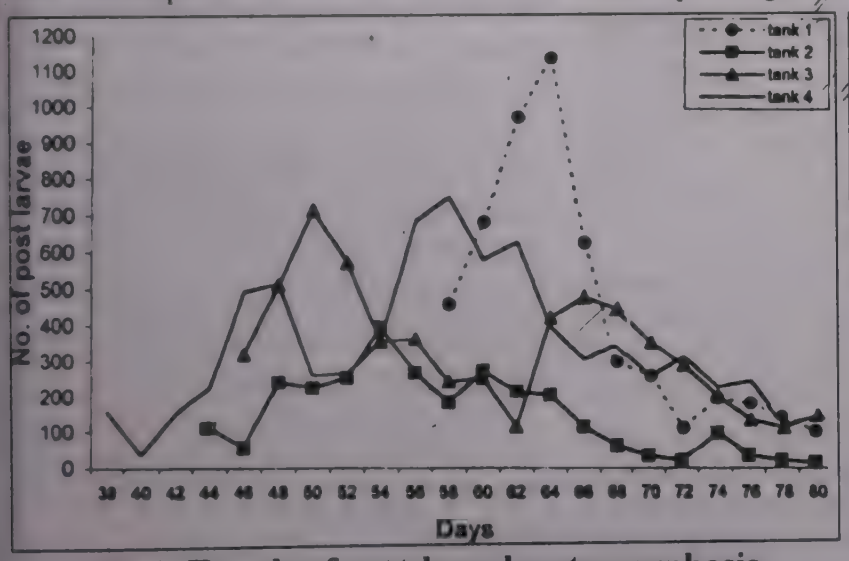

Fig 1: Trends of post-larval metamorphosis in four trials with M. malcolmsonii

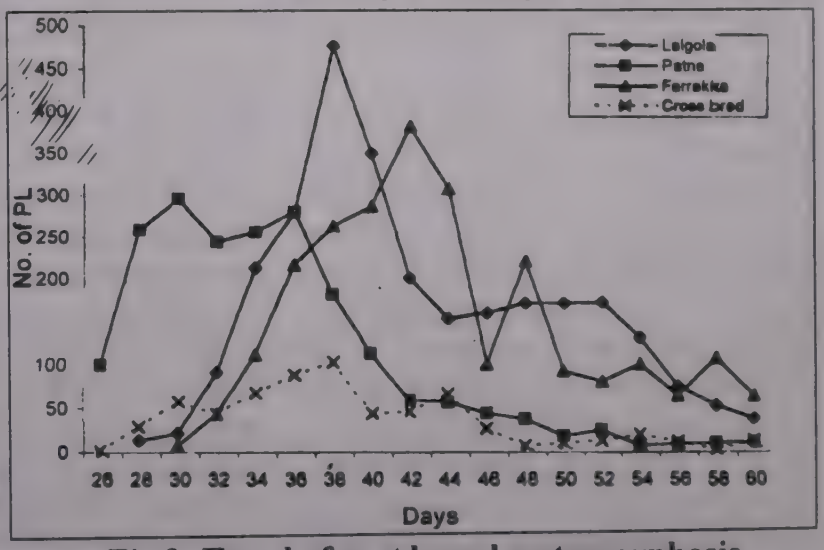

Fig 2: Trend of post larval metamorphosis in four trials with *M. gangeticum*

Gaint freshwater prawn *Macrobrachium rosenbergii*, Indian river prawn, *Macrobrachium malcolmsonii*, and Ganga river prawn *Macrobrachium gangeticum* spend their larval life swimming up side down and obliquely in the water column. Being planktonic in nature they are attracted towards the side having light (New and Singholka, 1985; Kanaujia and Mohanty, 1992; Kanaujia *et al.*, 2000). During breeding, mature females ovulate eggs inside the brood pouch, formed as the downward prolongation of first to fourth pleopods. The eggs get fertilised immediately after coming in contact of spermatozoa already present. These activities are completed within few minutes. The eggs are then incubated leading to the embryonic development. The embryo attains Zoea stage 1 within few days depending upon the water temperature, water quality and feed quality. At hatching, Zoea emerge out from the egg shell and start moving freely in the water column. The duration for attaining post larval stages for a complete batch under hatchery conditions is prolonged for all these three species. The first few post larvae emerged in 30 days and thereafter it took 20 days more for their total emergence in *M. rosenbergii*. In the case of *M. malcolmsonii* first post larvae emerged by 40 days and it took another 20 days for the emergence of the complete batch. In the case of *M.gangeticum* first post larvae emerged by 22 days and it took another 20 days for the complete batch to emerge as post-larvae. Because of prolonged duration of post larval metamorphosis, the young ones are required to be harvested daily and on time from the larval rearing tank in order to prevent cannibalism. Due to crawling nature of post-larvae, their harvesting from larval rearing tank is a difficult task and it is being done by reducing the water level of the tank adopting turn down drain system that may often put stress on the advanced larvae resulting in mortality. Hence attempts have been made by the authors at the Central Institute of Freshwater Aquaculture so as to pool up knowledge on the process of post larval metamorphosis in the tank concerned under hatchery conditions in order to develop a technique for harvesting the post larvae every day. The present communication provides a detailed discussion on the subject.

Design of shell string

Empty shells of the freshwater mussel *Lamellidens marginalis* and *L.corrianus* were stringed one after another using nylon thread (No.2) and plastc beads (5mm dia) (Fig.1). The size of the shells ranged from 40 to 70 mm in length and 25 to 35 mm in width. Two holes were drilled in each shell leaving a space of 10 to 15 mm from both ends on the long axis. The space between two holes was about 30 to 45 mm depending on the size of the shell. Each

Table 1: Showing details on occurrence of first post-larvae of *M.malcolmsonii*, total period for metamorphosis of a batch, post-larvae metamorphosis per day, PL per litre and total number of post-larvae from four tanks.

Tank No.	*Occurence of 1st PL(day)*	*Total period for PL metamorphosis*	*No.of PL harvested*	*Average PL/day*	*PL/litre*
1	49	32	5,197	162	17
2	40	41	2,570	67	9
3	42	39	6,303	161	21
4	39	42	7,360	175	25

Table 2: Occurrence of first post-larva of *M.gangetium*, total period for metamorphosis of a batch, post-larval metamorphosis per day, PL per litre and total number of pose-larvae from four trials.

Trial No.	*Occurrence of first PL*	*Period of metamorphosis*	*No. of PL harvested*	*Average PL/day*	*PL/litre*
1	22	38	2,793	73	9
2	22	34	2,025	59	6
3	26	30	2,472	82	8
4	24	34	666	19	2

shell was tagged with a piece of nylon thread and two beads were placed in between two shells. A total of 105 shells were tagged one over the other upto a total length of 45 cm. 15cm space was left free without any shells at the end of the thread, which was tagged with a 25 cm long stick kept across the tank to support the string shells hanging down into the tank and for lifting the same conveniently while harvesting the post larvae. The total length of the shell strings was about 60 cm, matching with the depth of the larval rearing tanks. The data collected from four larval rearing trials of *M.malcolmsonii* and *M.gangeticum* carried out in plastic pools (3' dia X 2' h) of 300 lit. water holding capacity under laboratory conditions are presented in Tables 1 and 2 above. Airlift-biofilter recirculatory system was adopted during rearing of larvae. The larval rearing techniques and management measures adopted during the study were the same as described by Kanaujia and Mohanty (1992).

Harvesting

All the larval stages of freshwater prawns *M.malcolmsonii* and *M. gangeticum* are planktonic; however, they need a suitable hiding place while moulting. After observing the first post larvae, few shell strings were hung from top of the tank keeping the shells submerged completely in the water. The advanced larvae while moulting and in metamorphosis into post larvae used the bowl type bed inside the shells. The post larvae thereafter rested on these shell beds after moulting. Shell strings were carefully lifted one after another from the rearing tank and kept in a PVC tub half filled with the water of the larval tank (Fig.2). The post larvae emerged out of the shell beds and started crawling on the bottom of the tub. This behaviour continued till almost all of them metamorphosed into post-larvae. The data on daily harvest from four larval rearing tanks are shown in Figure 1 & 2 and Tables 1 & 2. Observations on occurrence of first few post-larvae of *M.malcolmsonii* in four larval rearing tanks were recorded on 39th, 40th, 42nd and 49th day, whereas in the case of *M.gangeticum* this occurrence was recorded on 22nd, 24th and 26th day. The total period for post-larval metamorphosis of the entire batch of larvae of *M.malcolmsonii* prolonged from 32 to 42 days during which emergence of post larvae ranging from 2750 to 7360 nos. @ 9 to 25 pl/lit. was recorded in these trials, whereas in the case o *M.gangeticum* the total period for pos larval metamorphosis was 32 and 3 days during which total post-larval pro duction ranged from 666 to 2796 nos @ 2 to 9 pl/lit. The average recovery o 67 post-larvae per day in *M malcolmsonii* was recorded in one tank Almost a similar trend was found in an other three tanks with *M.gangeticum* i which the average recovery of 19 to 8 post larvae per day was recorded in fou trials. These data on production aspect are not, however, indicative of any trend for reaching any particular conclusion since there are several responsible fac tors influencing the life activities of in dividual species.

Discussion

The technique adopted by the au thors for harvesting the post larvae o *M.malcolmsonii* and *M.gangeticum* wa found to be more suitable and practical compared to any other techniques (New and Singholka, 1985) adopted earlier The turn down draining to siphoning methods are generally applied for har vesting the post larvae of *M.rosenbergi* where majority of larvae (90-95%) meta morphosed into post larvae within 10 t 15 days. Hence, these methods are no considered suitable for harvesting of the post larvae of *M.malcolmsonii* and *M.gangeticum*, since the post larva metamorphosis is extended over a longe period (20-40 days). Further, on keep ing the post larvae for a longer time competition for food and cannibalism i seen to hamper the normal developmen of other larvae. It is therefore desirable to harvest the post larvae without dis turbing the water and avoiding stress o other larvae in the rearing tank. Th String Shells Technique is found to b useful in this context.

Post larvae of *M.malcolmsonii* an *M.gangeticum* harvested from four tria tanks on different days indicated the pro cess of post larval metamorphosis in bot the species. These observations woul help in making further improvements i the techniques for seed production of th species. The stringed shell method o

Fig 1: Harvesting of post larvae with stringed shells

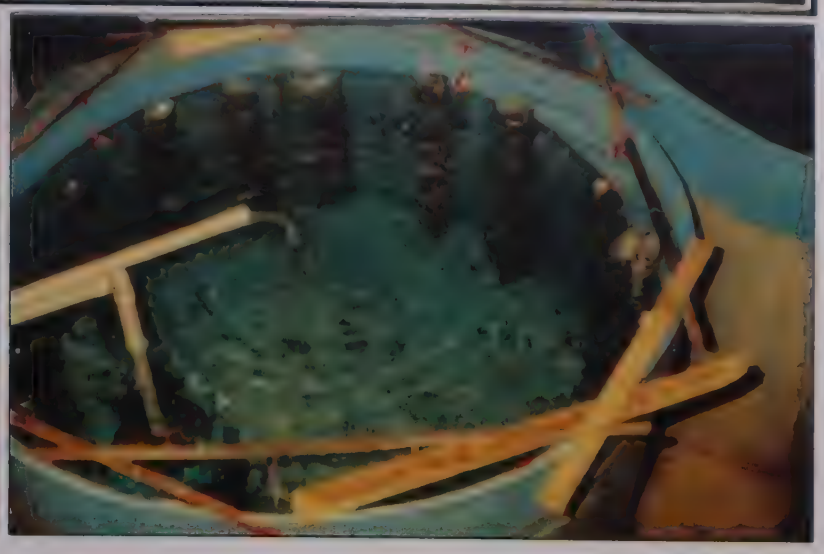

Fig 2: Hanging of stringed shells in larval rearing tank

harvesting of the post-larvae of the discussed freshwater prawn species may also be applicable for harvesting the post-larvae of other prawns, as this will reduce the time, labour and post larval mortality caused due to stress.

Acknowledgements

The authors express their sincere gratitude to the former Directors of Central Institute of Freshwater Aquaculture, Kausalganga, Dr.S.D.Tripathi, Dr. S.Ayyappan and Dr.C.Saha for their keen interest and encouragement during the course of this study.

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Demonstration-cum-Workshop on the Operation of TED

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Chairmanship of Dr.M.Rajagopalan, Head, Fishery Management and Administration, CMFRI, Kochi. Dr. B.C. Choudhary delivered his talk on "An overview of sea turtle conservation in India". Out of 8 important species available in the world, only four species namely Olive Ridley, Green turtle, Hawks Bill and Leather Back were found in Indian waters. Turtles were air breathers and could remain in submerged state for about 45 minutes. Mating took place in the sea. Groups of 17 to 18 females with one male partake in mating. The females would migrate to shore during Dec.- Feb. for laying eggs. On an average a female would lay 150 eggs, four times during its life. As the turtles possessed homing instinct, the hatchlings would come to the same shore after 25 years to lay eggs. Wild life Institute had divided AP coast in to three zones, namely; Northern (i) Ichchapuram to Kakinada Central, (ii) Kakinada to Machilipatnam, and (iii) Southern Machilipatnam to Pulicat for conducting survey and to obtain information on sea turtles. With only 0.001% of survival rate, the mortality at the identified zones were 46, 26 and 28 respectively per day. On an average 25,000 turtles were caught per year along Orissa coast and 1,268 only along AP coast. Thus there was an immediate need for research on migration, nesting and other phases and also on usage on Telemetry and Genetics, in Turtle development programmes, he concluded.

Technical Session-II: *Fisheries Interface Problems*

The Chair person of this technical session was Mr.C.Ilaiah, Addl. Director of Fisheries, Hyderabad. Dr.M. Rajagopalan, CMFRI, projected his views on "Incidental mortality of sea turtles in fishing gears". According to an estimate, he said that 90% mortality of sea turtles took place on east coast and only 10% on the west coast. His findings on studies in Tamil Nadu revealed 60% of incidental mortality from gill net, 13% from trawl net, and the rest from other gears, whereas in AP, mortality was 43% from gill net 17% from trawl net and the rest from other nets. The percentage of mortality was high during months of Jan.- Feb., estimated at 18.5%, 30.4%, and 16.8% respectively. He opined that as TED could not be used in gill nets, fishing by gill net during peak season of turtle breeding should be banned.

Dr. Percy Dawson, Scientist, CIFT Kochi, spoke on "Application of CIFT-TED for turtle conservation". He said TED was a Bycatch Reduction Device (BRD) which facilitated the escape of sea turtles during the operation of trawl net. Americans having developed the TED in 1980 imposed sanctions on

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Rearing of Rock Lobster Larvae

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Rock Lobsters are very important candidate species for mariculture. Six species of lobsters, *Panulirus homarus, P.polyphagus, P.ornatus, P.versicolor, P.penicilatus* and *P.longipes* are of common occurrence in the Bay of Bengal off the East coast of India. Because of their habit of living in rocky hideouts, these are commonly known as rock lobsters and because of the spiny armature on the body and appendages, these are also referred to as spiny lobsters. The major difference between the rock lobsters and the European lobsters is that the rock lobsters do not possess the powerful chelate legs, but they have a pair of long antenna. The presence of long antenna prevents the animal to move freely in enclosed habitats and small aquaria, a point of importance in the rearing of lobsters under laboratory conditions. The initial results of experiments on raising of mother lobsters, and embryonic and larval development of progeny are discussed in this paper.

Management of Berried Lobsters

Berried lobsters of *P.homarus* were collected from Chepala Kancheru, Bhimili, Visakhapatnam harbour waters, and a few other centres in A.P. and brought to the laboratory for experimental studies. During transportation, the lobsters were kept in large buckets containing seawater and the water was changed frequently during transportation. Care was taken to choose the female lobsters with brick red coloured egg mass on the abdomen (Fig. 1). After acclimatisation to the laboratory conditions for two days, the lobsters were subjected to prophylaxis. This was performed with solutions of dilute concentration of potassium permanganate and formaldehyde to prevent the development of bacterial and ciliate infections. Copper sulphate treatment was also given in between. After prophylaxis, the lobsters were transferred to 1.5 m diameter circular fibre tanks having a flow - through water exchange mechanism.

Fig 1: *P. ornatus* with egg mass on the abdomen, in rearing tank

Fig 2: Undeveloped eggs

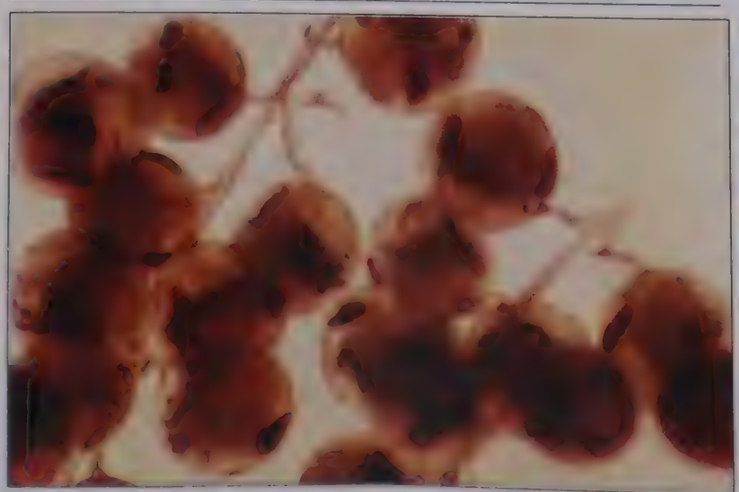

Fig 3: Advance stage of developing eggs

Fig 4 : Phyllosoma larva Stage - I

Continuous aeration and running treated seawater was provided during the experimentation.

As the incubation of eggs was in progress, the mother lobsters were fed with squid meat once in a day followed by thorough water exchange. Care was taken to siphon out any detached eggs or leftover feeds. Lobsters being stenohaline, during all these days of incubation, the salinity was maintained constant at 32-33 ppt. Experiments were conducted to study in detail the various embryonic developmental stages. The developing egg samples were collected at regular time intervals and the various stages were drawn under a microscope.

Embryonic development takes place inside the egg, when it is attached to the ovigerous hair of the pleopods (Fig. 2). Sixteen stages of developing eggs were observed in early embryonic development of *P.homarus* (Fig. 3). The egg passed through all these stages before hatching into phyllosoma larva (Fig. 4). The stage of development was observed through the transparent egg membrane under a microscope. The total time taken for embryonic development and tissue differentiation and organ formation is dependent on the water temperature and it took 8-20 days at temperatures of 31°C and 25-26°C respectively. The brick red colour of the egg changes during the course of the development to orange red, light yellow and finally the egg mass changed to light brown colour.

The egg was undeveloped in stage I and appeared brick red. Cleavage of eggs began in stage II. Little amount of yolk utilisation took place in stage III and subsequently, the developing egg passed through blastula stage and gastrulating stages by stage IX. During these stages, much of the yolk was utilised and yolk-free parts could be clearly recognised. A non-rhythmic heartbeat was seen on the mid-dorsal part in stage X. At this stage almost 60% of the yolk was consumed, indicating the development of different organelles. Egg mass at this stage became brown. Full differentiation of the eyes took place in XIII stage and fully differentiated larvae were seen in XVI stage. The egg mass appeared dark greyish black in this stage.

After complete development, the phyllosoma larva hatched out of the egg into the surrounding water. Hatching mostly took place during night time. The hatched larvae swam freely in the water. Such hatched phyllosoma larvae were collected by means of scoop nets and maintained in glass troughs, fibre troughs and large concrete tanks for further experimentation on larval development and feeding behaviour.

Experiments were conducted on the mass culture of phytoplankton with particular reference to *Chaetoceros* and this was used as feed to the first stage Phyllosoma larvae. The larvae could survive up to six days on this feed. Similarly *Spirulina* was also tested as feed on the first and second stage Phyllosoma larvae. Combination of phyto-and zooplankton was tried as feeds at different stages of Phyllosoma with success. The four phyllosoma larval stages identified differed markedly in their morphological features. Further experimentation is in progress on the metamorphosis of Phyllosoma to *Puerulus* stages.

Acknowledgements

We are grateful to the Department of Science & Technology (DST), Ministry of Science & Technology, Government of India for providing financial assistance to carry out this work. We also express our thanks to authorities of Andhra University for providing the necessary infrastructural facilities.

Demonstration-cum-Workshop on the Operation of TED

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ing trawls without TED under US law section 609. The code of conduct for responsible fisheries (FAO, 1995) gave guidelines for sustainable fisheries and prescribed the need for protecting endangered species like sea turtles. Experimentation with TEDs at Visakhapatnam and Paradeep revealed the escapement was at a factor of 1.2% and 0.62% respectively. Hence, he said that TEDs could be used without hesitation.

Mr. N.Varaprasada Rao, Div. Forest Officer, Wild Life Management Division, Rajahmundry spoke on "Role of Forest Development (Wild Life Division) in conservation of sea turtles. There being no sanctuary in AP, the Forest Dept. Staff took steps to protect nesting turtles at area located at Sacromento beach. He stressed on establishing Local Management Committees for the conservation of the turtles. As per Schedule 1 of Indian Wild Life Protection Act, 1972, the sea turtles were a protected species and prohibited from being used in any form of trading, and it was enforcing the Act effectively.

Dr. P.S.Rajasekhar, Faculty member, Andhra University, spoke on "Threats and conservation measures to protect Olive-Ridley sea turtles population along North Andhra Coast". He said several fishing gears namely, trawl net, gill net, seines caused mortality of sea turtles. During breeding season (Nov.-March) 2,000-3,000 broodstock were subjected to indiscriminate killing and on an average two numbers of dead turtles per km. were found. He revealed that 85% of the turtles were caught while in courtship, 12% during nesting and 3% trapped in nets. In addition, the animals like wild dogs, foxes, jackals etc., dug the nests and also attacked adult turtles. As one of the measures for conservation of sea turtles, he suggested introduction of education and awareness programmes, participatory rural appraisal scheme, use of TED, *in situ* protection of nests, protection and conservation of nesting sites from sand mining, erosion and pollution.

Mr. G.Venkata Raju, Asst. Director of, Fisheries (Marine), A.P., spoke on "Fisheries management in the conservation of sea turtles in Malaysia and

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Fisheries Management and the Role of Bio-Economics

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Fisheries Management has acquired added significance and concern in view of the mounting crisis in most of the maritime nations as 70 percent of the world's fish stocks are overfished and the destructive consequences of over exploitation are becoming increasingly apparent. This paper makes an attempt to review and examine the various management models that have been advocated and the management measures that have been implemented in different parts of the world. It focuses special attention on the bio-economic models and suggests modifications. The review reveals that the biological models manifested exclusively by fish population dynamics were replaced by the bio-economic models as a basis for fisheries management. These constitute improvements over the earlier models. Bio-economic models attempt to establish functional relathionships between specific characteristics of the natural resource base, i.e., the fishery resources, and the activities of man to make optimum use of such resources. Over the years, the bio-economic models have undergone refinements and modifications to suit the needs. However, some fundamental weaknesses have been exposed recently as they take little account of the tendency towards instability within oceanic environment and ignore complex species interaction, technological development, human behaviour, etc. The relevance of socio-economic factors in the success and failure of the regulatory system is becoming abundantly clear to the policy makers and practising managers. Social issues and cultural values are at least as important in fisheries management as biological and economic factors. The integration of co-management regimes into the bio-economic approach will go a long way in influencing the sustainability and durability of this management approach.

The most important characteristic feature of the world fisheries is the common property concept embodying open and free access to the resources and the almost universal absence of defined property rights. It permits its usage simultaneously by more than one individual or economic unit. No single individual has an exclusive right to its use and the extent of effort applied cannot be subjected to the restraints that govern exploitation of a solely owned resource. However, indiscriminate use of the resource with a view to maximising individual output leads to overfishing and depletion of the fishery and the consequent inefficient use of labour and capital (Subba Rao, 1986) which Hardin (1968) rightly called 'the Tragedy of the Commons'.

This paper makes an attempt to review and examine the role of bio-economic models in the management of fisheries resources and in the attainment of policy objectives by the coastal States. At the outset the paper sets out briefly the problem of overfishing and the management measures advocated and implemented in general, in a historic perspective. Then it moves on to present the genesis and development of bio-economic modelling, its objectives and contribution of FAO to this management approach. It also attempts to present briefly a summary of procedings of the bio-economic workshop organised for the demersal fisheries of the northeast coast of India, followed by a few suggestions.

The sustained increase in the world wide demand for fish as food and for industrial purposes and the commensurate rise in prices have considerably encouraged the entry of more fishing vessels equipped with sophisticated electronic equipments that strengthen harvesting technology for fishing in traditional, as well as, new fishing grounds. The result has been that the current harvesting capacity of the global fleet far exceeds the estimated biological sustainability of most commercial species and therefore, world fisheries are at a crucial and historic turning point as the fisheries resources around the world are closer to their optimal catch limits with many signs of biological degradation and economic waste (FAO, 1991).

Historians of economics observed a consistent pattern in the development o the fishing industry worldwide. I growth was marked by great bursts of ex pansion, triggered by discoveries of ne resources and new technology. Major in dustries were built on cod, fur seal whales, anchoveta and tuna, to name few. But none remained prosperous fo long. Some settled into a stable subsi tence activity. More often the industr was in continual disequilibrium with flu tuating resources or fluctuating market or both. But one way or another, they a seemed to slide into a condition of ge eral malaise, the usual symptoms which were overexploited and depresse stocks, over-expanded fleets and low i comes to fishermen and vessel owner (Pearse, 1996)

Biological principles have dominate the basic concepts of fisheries manag ment for around a century. Beginni with the pioneering work of Peterso (1894) and gradually refined by Russo (1931) and Graham (1935), the conce of biological modelling of fish stocks w finally formalised in Beverton & Hol treatise (1957), regarded as a crowni achievement in the scientific theory

fisheries management. Built on assumptions that most fish stocks are inherently stable, behave predictably under moderate levels of exploitation and tend towards an equilibrium state, the concept of fisheries management became, in principle, a relatively straightforward scientific exercise.

Most fisheries management concepts rest on the ability to reasonably assess the stock size of, and recruitment to, any given fishery. Most stock and recruitment models have been developed for temperate water species (cod, herring, etc.) where the major characteristic is that the fishery is overwhelmingly for a single species. The situation in tropical fisheries is diametrically different (some exceptions occur because of selective gear, for catching tuna for example). The predominant mode in the tropics is the occurrence of a multi-species fishery, sometimes containing hundreds of species. The commercial "target" species may be neither (a) the largest species, nor (b) the most numerous species in the catch, nor (c) a single species but a mix of species. Therefore, the usual models are often inappropriate for an understanding of such fisheries. (Edurdo A.Loayze. 1992 pp 4-7).

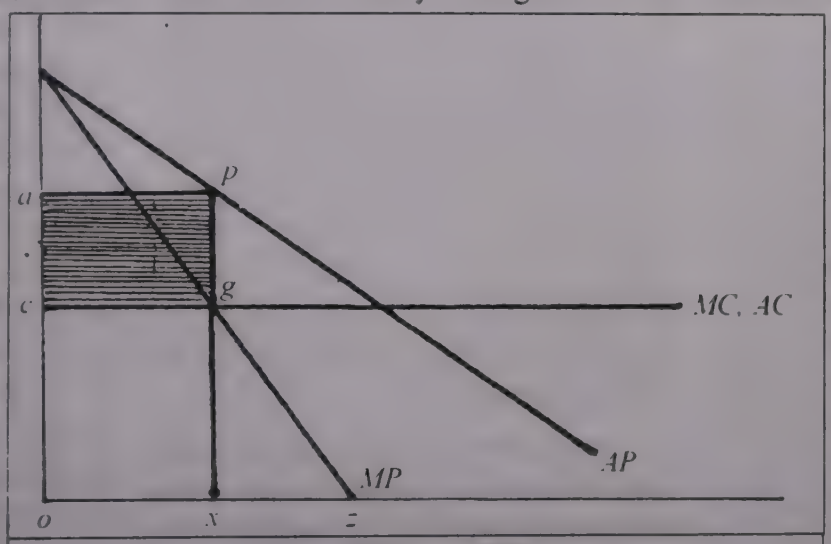

Fig. 1 Fishing Effort

Bio-Economic Modelling : Genesis and Development

The history of Bio-economics goes back to the seminal work of Scott Gordon in the early 1950s. Prior to this fisheries management decisions were based largely on biological principles and models of population dynamics. Gordon (1954) has introduced economic considerations into Schaefer's production model (1954) thus paving the way for a bio-economics era. The great bulk of research that has been carried out on the primary production phase of the fishing industry, as pointed out by Gordon, has so far been in the field of biology. Owing to the lack of theoretical economic research, biologists have been forced to extend the scope of their own thinking into the economic sphere and in some cases penetrating quite deeply, despite the lack of the analytical theory (See, Nesbit 1943, Talyor 1951, Beverton 1953, Burkenroad 1951). Virtually any specific research into the economics of fishery utilisation or about the economic characteristics of the fishing has not been undertaken, although there was a wealth of knowledge about the biology of the various commercial fisheries. Therefore, the research of Gordon has been directed at examination of the economic theory of natural resource utilisation as it pertains to the fishing industry.

Basing on the Schaefer-Gordon static model (Fig-1) a good deal of research work has been carried out to develop a large body of knowledge and literature and the thought processes have been further stretched with improvements and refinements both by biologists as well as economists thus leading to the development of refined bio-economic models. But most of these models involve considerable theoretical base and rather difficult mathematics (See Andersen 1984, Anderson 1981, 1986, Clark 1976, 1985, Clark and Kirk Wood 1979, Crutchfield 1981, Dow, Bell and Harrimen, 1975, Fullenbaum and Bell 1974, Hannesson 1983, Kollogg, 1985, Mc Connell and Sutinen 1979, McKenzie 1959, Mitchell, 1979, Rotschild and Balsiger 1971, Schaefer 1957, 1959, Talyor and Prochaska 1985, Terry and Balsiger 1981, Watt 1956, Waugh 1984) and very few of these have practical applications. The great advances in the application of bio-economic models as analytical tools for improving management decisions are more recent and closely associated with the declining costs of computing large amounts of data. In spite of these advances, the Gordon-Schaefer model still remain as the foundation for the bio-economic approach to the fisheries management as well as management decisions. The Schafer's model has made it possible to produce age-structured and cohort-based biological models, generally of the yield per recruit type which, while not overly sophisticated in mathematical terms, require considerable extent of computation time. In combination with modelling the economic aspects of the fisheries including prices, variable and fixed costs of harvesting and processing, profit-dependent investment behaviour, etc., bio-economic models have become more versatile in analysing and predicting the impacts of various management measures including area and seasonal closures, mesh size regulations and effort controls. In addition, and of particular relevance for managing shrimp fisheries, such models enable an assessment to be made of the interactions between artisanal and industrial fisheries and, in general, the interaction between different fleets using different gear and targeting on shrimps at different stages in their life cycle.

However, bio-economic model as a basis for fisheries management has been criticised on the ground that it contains some fundamental weaknesses. Caddy and Gulland (1985) assert that the theory takes little account of the tendency towards instability within the oceanic environment, and also it clearly oversimplifies the behavioural charcteristics of different stocks of fish and ignores the complex species interactions within the marine ecosystems through its insistence to date on reference to single species; and it fails to recognise the disruptive effects arising from the complex dynamics of scarce resources, technological development and human behaviour. The unforeseen consequences of environmental per-

turbation, where resource depletion may be triggered by natural events like elevated sea surface temperatures and reduced primary production associated with *El Nino* (Cavides and Fik, 1992) and climatic changes induced by global warming (Glantz, 1992). Further, Holm (1995) points that where the simplifications of the single species model destroy its predictive capabilities, the realism of multi-species models creates unmanageable complexities. Although challenged in theory and discredited in practice, bio-economic theory still remains the best available (McGoodwin, 1990) concept.

Objectives of Bio-Economic Modelling : Bio-economic models attempt to establish functional relationship between the specific characteristics of the natural resource base, i.e., the fishery resources, and the activities of man to make optimum use of such resources. The formalisation of such relationships, by necessity, implies that certain abstractions from reality must be made, or in other words, to introduce certain assumptions about the biological processes and about human behaviour. To the extent that these assumptions are violated in a specific fishery under study, the results of models should be considered 'idealistic' or biased. While the work of models increases with the validity of the assumptions, there are limits to formalising and to interpreting the results of highly complex systems. (Sparre and Willmann, 1992).

The basic objective of most modelling work in fisheries is to understand how public policies will affect the fishing industry and the consumers of fish. The basic purpose of bio-economic modelling may best be derived from the objectives of fisheries policies at large which include higher incomes to fishing families, better supply of fish to consumers, increased earnings of foreign exchange or the creation of employment. In more general terms, fisheries policies aim at improving the welfare of the people through (i) efficient allocation of scarce productive resources and (ii) equitable distribution of the net benefits created in the production process. (Mannesson, 1989). At the fisheries sector level, efficiency is related to optimal allocation of productive resources to the fish harvesting, processing and distribution systems, while distribution considerations will aim at equitable development of the different sections of the fishing communities and the bio-economic modelling is concerned with all these issues.

Contribution of FAO to Bio-Economic Modelling and Fisheries Management

In 1980s the Fisheries Department of the Food and Agriculture Organisation (FAO) too has initiated steps to develop computerized bio-economic models in order to assist its member countries in shrimp management decisions and in having indications of the potentially large economic benefits which can be obtained through improved management undertaken with the help of bio-economic modelling. It has undertaken several exercises with the help of micro-computer software and the present Bio-economic Analytical Model-4, popularly known as 'BEAM 4', the result of a process which took about a decade for the FAO and its staff to evolve.

In the initial attempt, the FAO has used the paper and pencil version of the Thompson and Bell (1934) yield per recruit model to assess the biological impact of closed seasons in the Gulf between Iran and the Arabian Peninsula. Kuwait shrimp fishery was taken for the analysis with only one species and two fleets (Garcia and by Van Zalinga, 1982). But the simulations were done manually by the participants on simple worksheets, different teams analysing different options. With a view to modelling a larger number of options in a reasonably short time, the above model was computerised and named as Bio-Economic Analytical Model-1 (BEAM-1). This model was elaborated further as BEAM-2 to handle commercial categories (Coppala, Garcia and Willmann, 1992). However, these are simple models and cannot be considered as much more than training tools for an introduction to bio-economics and identificatio of the major trade offs. In order to hav a more powerful analysis of comple fisheries leading to policy decisio BEAM-3 was developed (Cochet an Gilly, 1990). This is a stochastic mod that can handle upto four species an many fleets operating sequentially an simultaneously.

BEAM 4 is a much more genera programme and represents the ultimat stage of development in FAO, for suc deterministic bio-economic simulatio models. The objective of BEAM 4 is t predict catch, value and a series of mea sures of economic performance, includ ing generation of resource rents, valu added to the national economy, net fo eign exchange earnings and employmer as a function of fisheries managemer measures such as effort controls, clos seasons and areas, and minimal mesh siz regulation as needed. It is a versatile too for the rational mangement of exploite living aquatic resources and can deal wit a system of several stocks, several fleets several areas (fishing grounds), and sev eral processing plants. It also allows fo different migratory behaviours of shrim and other species, as well as seasonalit of recruitment. The model behin BEAM 4 is an age-structured, cohor based fish stock assessment model con bined with an economic model of th various fleets and processing plants. I economic calculations are similar t those performed in BEAM 1. The mod was originally designed for shrimp fish eries, building on the experience gaine with BEAM 1 and BEAM 2, but its ge eral features allow for its use for any fis ery. It was tested on shrimp fisheries o Madagascar (SWIOP/CNRO, 1989 Tanzania (SWIOP/MNRT, 1989) an Malaysia (1990).

Bio-Economics of the Demersal Fisheries off the Northeast Coast of India

This section presents the summary re sults of the Workshop on the bio-econom ics of the demersal fisheries off the nort east coast of India (FAO, 1993) whic was organised by FAO DANIDA

CMFRI and FSI during February, 1993 at Visakhapatnam, Andhra Pradesh, India. One of the aims of the Workshop was to present the bio-economic methodology and its application to the demersal fisheries, particularly, shrimp fisheries, off the northeast coast of India and to train the participants in its application. It was also intended to demonstrate the usefulness of research and the analysis of biological and economic data to prepare the background material needed for management decisions. BEAM 4 was used to analyse the shrimp fisheries of the northeast coast region comprising the States of Andhra Pradesh, Orissa and West Bengal.

The fishery is supported by a mixture of shrimp resources along the coasts of the above States. Shrimp fishery development along upper east coast originally started in Andhra Pradesh but when it appeared that the bulk of the resources was in the northern part of the Sandheads near Orissa and West Bengal coasts, the fishery exploitation underwent a general shifting in a northern direction, first from Kakinada to Visakhapatnam and then to Paradeep in Orissa as the base, in order to exploit the fishery resources within the limits of territorial waters which fall under its jurisdiction.

The lure of earning higher foreign exchange through exports of seafoods has led to the rapid development of shrimp fisheries in the above region in the wake of the development of a major fishing harbour in Visakhapatnam and the development of a fleet of large trawlers through acquisition from abroad as well as from Indian shipyards with government's support by way of loans and subsidies. Similarly, a large fleet of mechanised boats was also developed very rapidly. Both fleets supported a booming shrimp export industry. Soon catch rates started to decline drastically. Signs of stress and conflicts started to appear in 1987 when there was a low availability of shrimp and in the 1990s when competition between fleets and very poor economic results became evident. Besides, the overall management of the resource was extremely complex and involved the three States as well as the CMFRI, an Institute of Indian Council of Agricultural Research and the Fishery Survey of India (FSI) of the Ministry of Agriculture, as they dealt with differing functions and collection of different types of data. This very complex management and research situation combined with the fact that the industry showed clear signs of stress necessitated taking this fishery as the subject of bio-economic analysis. The basis of bio-economics is to combine biological fish stock assessment and prediction models with economic data inputs. The outputs of bio-economic modelling, as already specified, can be used to assess the biological and economic effects of management or development measures or changes in the fisheries induced by other causes. The biological input parameters considered for this exercise included groups of different species of fish and their age groups. The species groups included four commercial categories of shrimps (tiger, white, brown and small), cephalopods and four commercial categories of finfish (A, B, C, D groups). The age groups of above species groups considered for the simulation exercise were from one month to 12 months. Initially, it was thought of considering nursery grounds as well as fishing grounds; However, finally the latter alone were taken into account for the exercise. All the five categories of fishing vessels operating in the region such as large trawlers (23-28 m LoA), mini-trawlers (15-18 m LoA), sona boats (abt 10 m LoA), small mechanized boats (abt 9 m LoA) and artisanal craft were also included in the exercise. Similarly, three components of processing facilities, viz., shrimp processing plants, the pseudo-plants i.e., fresh fish markets and discards (mainly of fish) were also used. The economic input data used for the exercise were 1) harvesting costs, 2) processing costs and 3) sale prices. The year 1991 was taken as the reference period for the entire analysis.

The biological data on shrimp resources, fin fish bycatches and discards were obtained from CMFRI, FSI and other agencies, while economic data relating to costs and returns of different types of fishing vessels and shrimp processing plants were based on sample survey as well as information provided by industrial enterprises. With the available data, a number of simulations were examined with six assumptions so as to obtain different kinds of scenarios and to review the effects of different management measures. First, a variation of fishing effort of all fleets, using the same effort to all fleets simultaneously was considered. Next, a variation of fishing effort of all fleets, except the artisanal crafts and so on were examined. This workshop of short duration (10 days) attempted the analysis of data primarily as a training programme and therefore resorted to approximations as in the case of the compromise on using the same growth parameters for both sexes of shrimp or the compromise on the same fishing mortality for all species. Nevertheless, the outputs of simulations confirmed the general observations that the overall situation of the fisheries would not improve by continuous increase of fishing effort, that a general reduction of effort would be beneficial, and that the fleets of mini-trawlers and large trawlers (Fig. 2 & 3) were the least economical. Therefore, the bio-economic exercise, it was concluded, was a worth while exercise and that the results of the few simulations done seem to reflect the actual situation rather well.

Another important conclusion that emerged from the Workshop was that the existing data base was not satisfactory and towards this end a total of 17 recommendations were made to improve the data base in close cooperation with all parties concerned including CMFRI, FSI, MPEDA, State Fisheries Departments, and the fishing industry as a whole. This was suggested as a first priority in order to hold the second Bio-economic workhsop in 1994 or early 1995 for reliable assessment of the bio-economic situation with improved database. Another priority identified was the preparation of sets of possible fishery management measures as a basis for discussion and future action by all management bod-

ies concerned. Unfortunately, no such efforts were made to implement the recommendations of the workshop either to improve the data base or to hold a second bio-economic workshop for evolving better management measures, either by the government or its agencies or by the industry thus making the above exercise as a futile and redundant one.

Conclusions

Successful bio-economic exercises undertaken elsewhere made helpful suggestions for better management measures and future policy decisions. For example, for the bio-economic modelling of cephalopod fishery, Morocco (Cunningham, *et al*, 1996) proposed several management measures that could be implemented in three phases, viz., a) immediate measures b) medium-term measures and c) long term measures. The immediate measures proposed include : increasing mesh size to 80 mm, closure of coastal nursery areas, declaration of three-month closed season, licensing limited number of vessels, logbook to be kept by all vessels and enforcing rigorous high-seas control system. The medium term measures were to reduce the number of licenses, repatriation of the Moroccan fleet and landings-based control system. Lastly, the long term measures suggested were : transform licenses to ITOs, i.e., Individual transferable quotas, end annual closed season and foreign vessels to land catches in Morocco. Some suggestions were rejected by the government of Morocco and some were implemented. Therefore, the success and failure of these measures would ultimately depend on the political decisions at the government level and on the implementing agencies. But the scientists and economists must make rigorous exercises before offering concrete suggestions for management visualising the repercussions.

Policies for resource management may destabilise the lives of a number of fishermen, industrial workers and others in fishing dependent regions. This destabilisation should be balanced by social objectives, which stabilise some of the central elements of the reference systems of these people. The near anomie condition of fishing community and its alienation from the management system had sparked off direct action and civil disobedience both on land and sea. Therefore, there is a definite need for the reformulation of the objectives for fisheries management and, in particular, the need to incorporate a social dimension in fisheries policy. Hitherto, social issues have been treated as 'externalities' of the bio-economic model and thus left to other policy areas to address. Now the time has come, that the value systems and cultural aspects of the fishermen deserve greater attention, among others, and there is also increasing recognition that fisheries management is best handled at a local level, with co-management as the basis, where the need to protect the social infrastructure is most readily

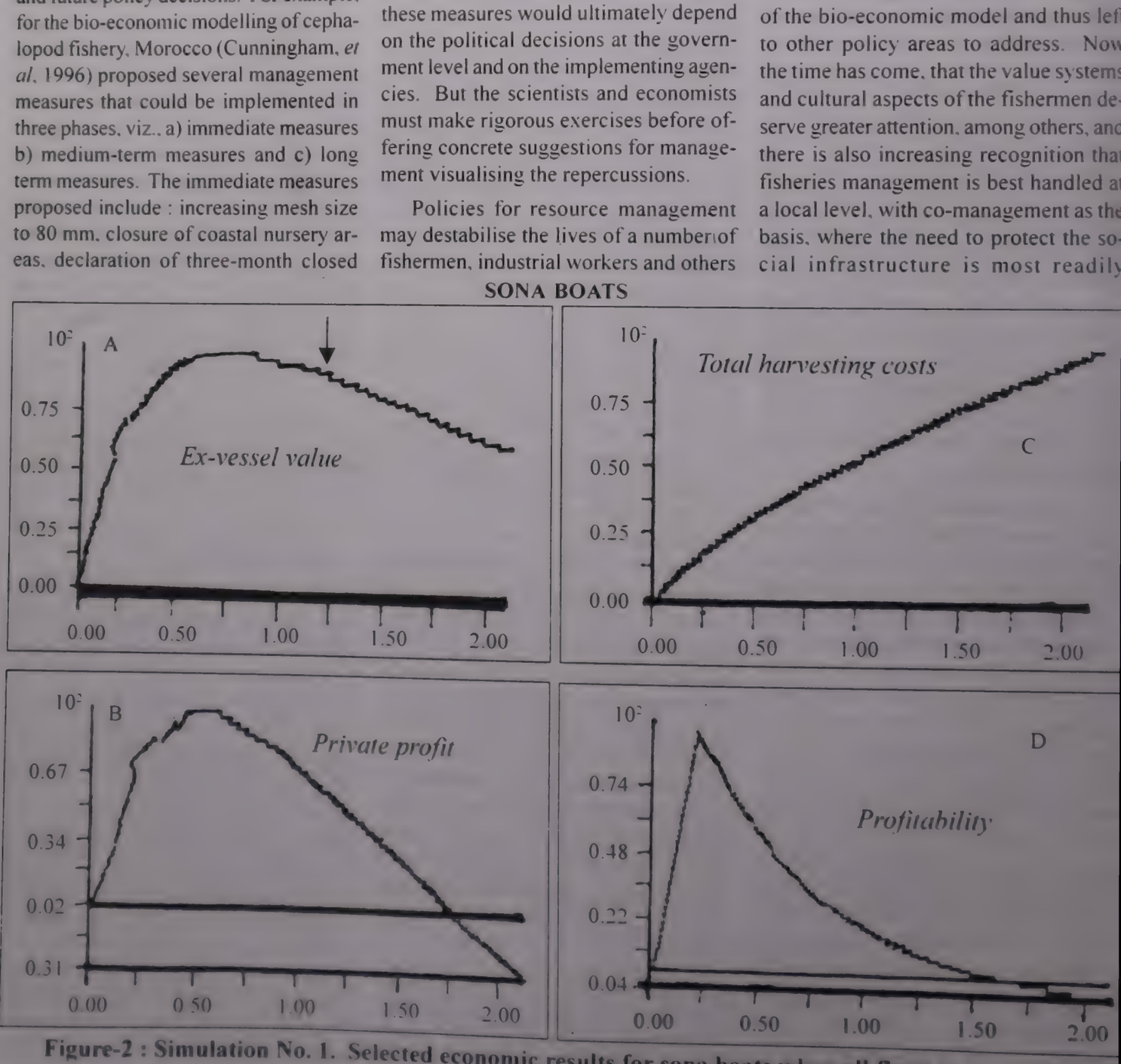

Figure-2 : Simulation No. 1. Selected economic results for sona boats when all fleets are variable.

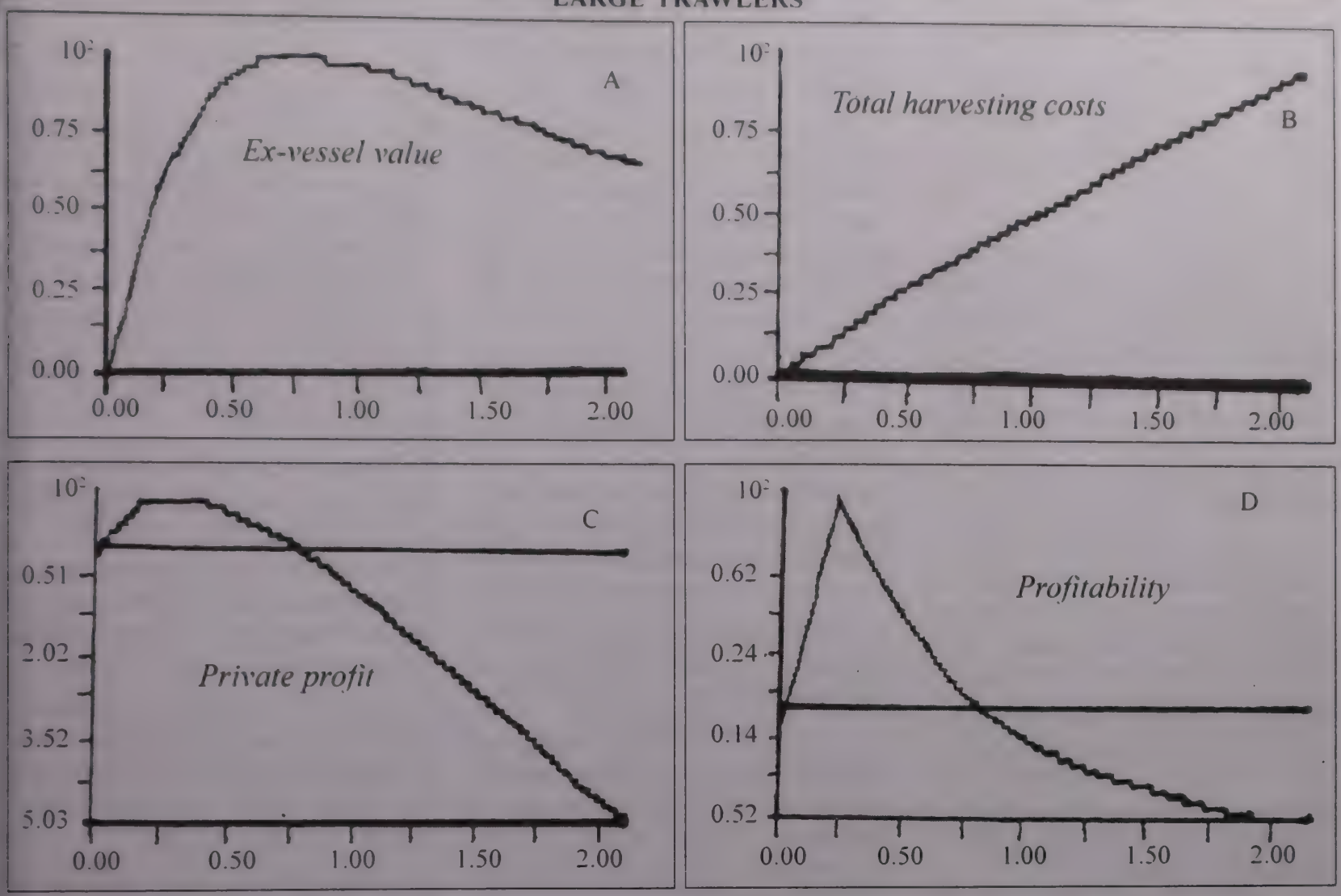

Figure-3 : Simulation No.1. Selected economic results for large trawlers when all fleets are variable.

recognised. Therefore, integration of social dimension and co-management regimes into the bio-economic approach will go a long way in influencing the sustainability and durability of this management approach.

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Demonstration-cum-Workshop on the Operation of TED

Continued from P.121

Australia and its relevance to Indian context". The speaker visited, alaysia and Australia as one of 16 member delegation during Sept.2001 and he spoke on his experiences on developmental strategies for the conservation of sea turtles in those countries. He spoke on main areas of concern: 1) Biology, distribution and population; 2) threats and mortalities; 3) conservation measures and 4) monitoring, control and surveillance (MCS). He indicated some of the strategies that could be adopted, such as: 1) Preparation of fisheries management plans on the basis of research studies; 2) formulation of need based regulations, covering period, area, type of gear etc.; 3) appropriate design of TED to reduce the loss of fish catch; 4) promotion of tourism in the areas of mass nesting; 5) conservation measures with the participation of fishermen and 6) involvement of NGOs, CBOs and other local bodies.

Dr. L. Ramalingam, Scientist, Fishery Survey of India, Visakhapatnam, explained the role of FSI in carrying out TED-based research surveys. He also said FSI would soon be adding TEDs designed by CIFT to trawl nets operated by FSI's vessels. Mrs. Asha Parmeswaran, Assistant Director, MPEDA, Visakhapatnam, said MPEDA had so far distributed 95 TEDs in AP and was planning to supply many more in future.

Technical Session III: ***Role of Fishermen and Social responsibility in the Conservation of Sea Turtles***

The Chairperson of this session was Mr. Y.Prakasa Rao, Joint Director of Fisheries (coast), Kakinada. Mr.Pradip Kumar Nath, Founder, SPCA, Visakhapatnam spoke on "Efforts to save, protect and conserve the endangered sea turtles". He said SPCA was making efforts for the conservation of sea turtles by protecting the nests, eggs and hatchlings. During 1996-'97 and 2000-2001, SPCA protected 998 nets, 119,760 eggs and 107,727 hatchlings. Mr. K.V. Ramana Murty, of Green Mercy, Visakhapatnam spoke on "Green Mercy's Mission to save sea turtles". Its mission was to save males and females during courtship, which took place from Nov.-April, the nesting females, nests and the hatchlings. Altogether, 101 nests were protected by creating awareness and education programmes.

Session III was followed by a plenary session, chaired by Dr. B.C. Choudhary. The participants were requested to suggest suitable recommendation on TED and on sea turtle conservation. Taking these into account, the following recommendations were made.

Recommendations

Protection, Enforcement & Regulation

1) Interdepartmental co-ordination among concerned state Govt. Departments i.e., Fisheries and Forest departments in collaboration with Wildlife Institute of India, ICAR Institutes, fishermen and NGOs is necessary for conservation of turtles.

2) As the status of sea turtles varies from State to State, strategies for conservation should be as per local conditions.

3) National Marine Turtle Conservation Policy is to be formulated.

4) Existing legislations need to be reviewed.

5) Reclamation of beaches and protection of nesting beaches should be taken by the Forest Dept.

6) Illumination of nesting beaches by hatcheries should be lessened during nesting seaon.

7) The use of the TED in shrimp trawling, as prescribed in the A.P.Marine Fishing Regulation Act, should be strictly implemented.

8) An attempt should be made on collection of data on incidental mortality of turtles in fishing gear along the Andhra Pradesh coast

9) Proper regulatory measures for mitigating incidental mortality in gill nets should be formulated by the Fisheries Department and the CIFT.

10) The proposal to declare certain areas in A.P. near the Orissa border as turtle sanctuaries needs to be considered.

11) A long term Action Plan covering atleast 10 years should be prepared for effective conservation of sea turtles.

12) All nesting beaches along the coastline to be identified.

13) Feedback from the fisheries department and fishermen must be taken into consideration for future TED designs.

14) The State Institute of Fisheries Technology, Kakinada in coordination with the Joint Director of Fisheries (coast) and NGOs need to work out Action Plans at village level.

15) Eco-tourism to be linked with conservation of turtles.

Monitoring, Research & Evaluation

1) (a) The use of the TED by the fishing trawlers has to be monitored at sea by means of patrol boats; (b) Nesting zones along the entire coastline of A.P. to be surveyed and monitored for nesting and incidental mortality; landside monitoring to be done by the Forest dept and out at sea to be undertaken by the Fisheries Dept., (c) Monitoring the regulatory measures should be taken by the Fisheries Officials of the concerned areas.

2) Apex monitoring team to be set up comprising officials of Save Turtle Team of S.I.F.T. other departmental officers of A.P. State fisheries, Forest Department, CMFRI, Andhra university, N.G.Os and local fishermen.

3) Ongoing research on TED tech-

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The Status of Fishing Vessels Operatives Training in India

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One ramerkable development in the past 50 years in the Indian marine fisheries sector is the transformation of a subsistence-oriented traditional fishery of the country to a market-oriented commercial fishery. Today 1400 fishing villages along the Indian coastline depend either completely or partially on the sea for their livelihood. Statistics reveal that 7.38 lakhs of full time fishermen along with 7.13 lakhs of part time fishermen venture into sea for fishing from these villages. An additional population of 10.30 lakhs also engage themselves in fishery related activities *(Anon, 2000)*. Fishing is in the nature of a global activity requiring diversified skills and expertise.

The begining of technological development in Indian Fisheries was in the post-independence era that started in 1947 but took shape in early 1950s. The highlight of this development activity in the marine sector was mechanisation and motorisation of the traditional crafts during the early years of independent India. These improved new crafts needed an altogether different kind of technical expertise as operations of engine/motor/winches are involved and there was also the need for related focal vocational training to all categories of crew on board. Traditionally, training in fishing has been by way of transfer of skills from father to son through actual hands-on participation in various activities on board. Not surprisingly, the modernisation of the fleet had put an end to the above concept and motivated the taking up of new line of training programme, involving operation of engine, winch, new types of nets etc.

Organised fisheries training in India started in 1945 with two all India training programmes, one on Marine fisheries at Mandapam Camp and the other on Inland fisheries at Barrackpore. However, for long, training of manpower to meet the requirements for the operation of fishing vessels was not thought of, despite the awareness of its need. Realising the requirement, however, Fishermen's Training Centres were established in all Maritime States for training of fishermen in the operation of mechanised/motorised fishing boats.

With increasing outlay in the successive five year plans, Indian fish production consistently expanded. In the meantime the Merchant Shipping Act had also stipulated statutory requirement of competent certificated hands for manning ocean going fishing vessels. The Government of India, in 1959, constituted a Committee on "Fisheries Education", for assessing the manpower requirements of the fisheries sector and to suggest measures for building up trained manpower for promoting fishery developmental activities. CIFNET, (Earlier Known as Central Institute of Fisheries Operatives), was thus established in 1963 on the recommendation of above mentioned Committee to meet the trained manpower needs of ocean going fishing vessels and that of fishing industry (Abidi, Biradar - 2001).

CIFNET of early years

Central Institute of Fisheries Operatives was established at Kochi in 1963. The name was later upgraded consistent with its functions as 'Central Institute of Fisheries Nautical Engineering Training' (CIFNET). Subsequently two Units of CIFNET were established, one at Chennai in 1968 and another at Visakhapatnam in 1981, for meeting the additional requirement of manpower necessitated by the expansion of the fishing fleet. The Institute imparts core training for the fishing vessel deck and engine cadets of to enable them to appear for the respective competency examinations conducted by the Mercantile Marine Department (MMD), after acquiring the prescribed sea service. Requirement of operatives of fishing vessels basically springs from statutory laws. The Merchant Shipping Act 1958 is specific on the manning requirement for larger fishing vessels as given Table 1.

CIFNET imparts theoretical and practical training for these categories of personnel. By virtue of the training at CIFNET, the trained candidates become eligible to get a permitted remission of sea service required, when they are allowed to appear for the respective competency examinations.

Table 1 : Manning rules - M.S.Act 1958

Vessel categories	*Manning requirement*
Vessel between 25 to 50 GRT	Certified Skipper
Vessel more than 50 GRT	Certified Skipper. Certified Second hand
Vessel with engine of 50 nominal HP or more	Ceritifed Engineer of a Fishing Vessel
Vessel with engine of less than 50 nominal HP	Certified Engineer of a Fishing Vessel or Certified Engine Driver of a Fishing Vessel

The statistics of candidates trained till now and number of candidates who passed different competency examinations are given in Table 2.

Vessels of categories of less than 25 GRT are normally manned by not-cer

tificated personnel. These are mainly operated by traditional fishermen hailing from fishing villages. The State fisheries departments of respective maritime States impart the training to these fishermen at their training centres.

Training of Marine Fisheries Operatives : CIFNET's Contribution

A comprehensive analysis of the Traditional Fisheries sector and the Industrial Fishing Sector is attempted as follows.

Traditional Fisheries: The traditional fishermen undertake fishing within territorial waters, mostly in inshore waters, for their livelihood. The mechanisation/ motorisation of the traditional fishing crafts and introduction of new fishing techniques have enabled the fishermen to venture into farther waters. Today, with the introduction of sophisticated electronic gadgets for navigation, fish finding, and equipment for fish handling and fish preservation, this sector has leaped forward to a new dimension. Training needs on various aspects for this sector during the early years are directly met by the respective state fisheries departments. While this system continues, with attractive subsidies on machineries and equipment by the Governments concerned in the recent years, promotional agencies like MPEDA also now undertake training programmes with the help of other agencies in specific areas such as operation of electronic equipments.

CIFNET has been making valuable contributions in the training of manpower for larger fishing vessels. The Institute has been conducting from its inception ancillary and short term courses on diversified disciplines and also has been providing training to teachers, State fisheries developmental officials etc., who in turn impart training to the fishermen. Table 2 gives the details of number of candidates trained by CIFNET so far and number of candidates who received competency certificates.

Table 2 : Details of Trained Manpower *upto 1999*

Candidates trained by CIFNET		*Candidates who obtained competency exams of MMD*	
Name of course	*No.*	*Name of competency exam*	*No.*
Mate of Fishing Vessel	1866	Skipper Grade I	01
Engine Driver of Fishing Vessel	1865	Skipper Grade II	610
		Mate Fishing Vessel	310
		Second hand Fishing Vessel	857
		Engineer Fishing Vessel	206
		Engine Driver Fishing Vessel	700

It may be seen from Table 3 that Advanced Diploma in Fishing Gear Technology Course (ADFGTC), Engineer (Fishing Vessel) Course for Diploma Holders in Mechanical Engineering (EDME), Radio Telephone Operators Course (RTOC), Gear Technicians Course (GTC), Boat Building Foreman Course (BBFC), Shore Mechanics Course (SMC) and Teacher Training Course (TTC) which were conducted as ancillary courses at CIFNET received greater response from Karnataka, Kerala and Lakshadweep.

Table 3 : Manpower trained in ancillary courses by CIFNET

Sl. No.	*Name of UT/State/ Other categories*	*ADFGTC*	*EDME*	*RTOC*	*GTC*	*BBFC*	*SMC*	*TTC*
1.	Andaman and Nicobar	--	--	--	03	03	04	02
2.	Andhra Pradesh	01	--	07	07	--	02	--
3.	Assam	--	--	--	--	01	--	--
4.	Goa	--	--	02	01	--	03	--
5.	Gujarat	--	--	02	12	07	01	--
6.	I.C.A.R.	--	--	01	--	--	--	--
7.	Jammu & Kashmir	02	--	--	--	--	--	--
8.	Karnataka	01	01	13	08	02	14	--
9.	Kerala	--	--	20	22	29	15	12
10.	Lakshadweep	--	--	13	01	03	59	01
11.	Madhya Pradesh	--	--	--	01	--	--	--
12.	Maharashtra	--	--	01	04	02	14	--
13.	Manipur	02	--	--	--	--	--	--
14.	Orissa	--	--	02	06	02	04	06
15.	Overseas	11	--	01	10	01	07	--
16.	Pondicherry	--	01	--	04	01	36	--
17.	Private	--	--	101	26	35	64	--
18.	Private Industry	--	16	47	09	06	19	--
19.	Tamil Nadu	01	01	09	17	05	06	07
20.	Uthar Pradesh	--	01	--	04	--	--	--
21.	West Bengal	02	--	--	07	02	14	04
	Total	20	20	219	144	99	262	32

Commercial Fishing Industry

As a result of the developmental plans formulated by the Government of India, 28 commercial trawlers of Mexican design were added to the Indian fleet in late 1970s, and the fleet was further strengthened in the following decades raising fleet strength to 190 nos. The strengthening of the fleet in this manner provided a viable means for the transfer of results of fisheries survey and experimental fishing undertaken by the fleets of Fishery Survey of India and of some of the state fisheries departments. The encouraging results in locating potentially rich fishing grounds and the confidence gained in the operation by the floating personnel, motivated the private entrepreneurs to venture into fishing from early 1970s and to establish it as an export-oriented industry. The twenty years from mid seventies had

witnessed the expansion of fishing in Indian waters, which paved the way for strengthening the fishing fleet of larger vessels untill early 1990s, after which there was a fall in fleet strength, for reasons of age, other problems. The details of the growth and decline of the fleet strength are furnished in Table 4.

Most of the vessels are manned and commanded by CIFNET trained personnel. The untiring efforts of these qualified personnel placed India in the Shrimp Atlas of the World. The dedicated work and the proven ability also helped CIFNET trained candidates to acquire many commendable positions in the marine fishing enterprises in Nigeria, middle-east and several other foreign countries.

Table 4 : Growth and decline of fishing fleet of larger vessels

Period	*No. of vessels*
Late 1960s	18
Early 1970s	39
Late 1970s	49
Early 1980s	57
Late 1980s	171
Early 1990s	175
Late 1990s	111
Early 2000	71
Present	60

CIFNET's training vessel, during the course of experimental fishing as part of training voyages, has contributed in locating productive tuna grounds in Indian EEZ which had motivated intensive tuna fishing by joint venture projects between Taiwanese-manned and Indian enterprises. Besides the exploration of new fishing grounds, CIFNET could also induct a sizeable group of trained manpower in tuna fishing.

The Present Complexion of Fishing Vessel Operatives Training

Training has been interlinked at every stage with marine fishery developmental activities. During the initial years, the erstwhile Deep Sea Fishing Station, provided the first ever on board practical orientation for young cadets opting for fishing career. This was followed by systematic fishing vessel operatives training in theoretical and practical aspects, with the establishment of CIFNET. The systematic training programme instilled self confidence in the candidates, motivating them to acquire technology-oriented fishing skills. As a result, the Indian marine fisheries sector could achieve the following :

- Familiarisation with and successful adoption of trawling technique in Indian waters.
- Exploration and location of new potentially rich shrimp grounds,
- Establishing successful tuna fishery in Indian EEZ, and
- Imparting export orientation to commercial fishing activities.

These achievements became possible largely because of CIFNET-trained operative manpower has contributed a great deal in achieving the above mentioned goals. It is an established fact that fishing vessels operative training of the initial years had helped in establishing a commercially-oriented fishery industry in the country and CIFNET had been behind this success.

There is, however, a different scenario now, because recession has set in all over and fisheries sector is no exception. The number of government owned fishing vessels has drastically come down. Over-exploitation of shrimp stocks consequent to the introduction of a large number of vessels, fluctuating prices in international market, and the recent socio-economic problems faced all over the World particularly in the main importing markets for Indian shrimp viz., Japan and USA and other teething problems faced by the Indian fishing industry had compelled the exploration of possibility of diversification of the fishing activities towards the untapped oceanic resources of Indian EEZ. At the same time there has been a decline in the industrial fleet strength with practically no additions for obvious reasons. To state differently, the medium or larger fishing fleet of the country is not likely to grow in the near future as the present deep sea fishing policy and the 10th plan have not provided any encouraging slant. The direct impact of the declining fleet strength will of course be on the manpower requirement for the operation of the fleet which has a direct bearing on the status of utilisation of trained manpower produced by the CIFNET.

Training Courses conducted at CIFNET

CIFNET trainees both on deck and engine side undergo 18 months of Institutional training. These trainees get a remission of 12 months of sea time by virtue of undergoing the course at CIFNET, after which they would have to acquire the following qualifying sea service to make them eligible to appear for responsible competency examinations with MMD (Table 5).

Table 5 : Qualifying sea service for CIFNET trainees

Name of the Course	*Qualifying sea service required*
Mate Fishing Vessel	24 months
Engine Driver Fishing Vessels	15 months or 9 months + 6 months workshop apprentice

CIFNET has a capacity to train 100 candidates in deck and engine disciplines in each batch. Considering 70% result, these 70 candidates each of deck and engine side have to acquire the qualifying service as stated above, to make them eligible to appear for respective competency examinations. The candidates depend on the vessels of CIFNET, IFP and FSI to acquire the required sea service for which, one has to wait for his turn to get posting as a trainee in any one of the falling vacancies, through CIFNET. (IFP being left with no training positions as on date after the transfer of their vessels).

Till early 1990s the candidates were not experiencing the pinch of this lead time because of the availability of a good number of vessels both with the Government and in private sector. The de-

Table 6 : Trainee berths for CIFNET trainees on Govt. vessels

	Category	*CIFNET*	*FSI*	*Total*
Deck side	Jr. Deckhand	12	31	43
Engine side	Engine Room Assistant	11	9	20
	Jr.Deckhand-cum-Greaser	--	9	9
	Total	23	49	71

crease in the number of vessels on the whole as projected in Table 4 reduced the training berths for the CIFNET trainees for acquiring sea service. The situation can be improved only when adequate trainee berths are provided by the entrepreneurs in their vessels for CIFNET trainees to enable them to acquire the sea service. Protracted efforts were made by CIFNET in this direction on several occasions and at different levels with the private vessel operators and the entrepreneurs including the Association of Indian Fisheries Industries for provision of atleast one berth in each of the vessel for CIFNET trainees. Unfortunately as on date these efforts could yield no tangible results.

As a result, the CIFNET trainees either wait for their turn for getting a trainee berth or approach the concerned on their own for getting short term postings for acquiring the sea service. Even though the industry recognises the ability and standard of these trainees, seldom are they provided with trainee berths owing to their own constraints. The result is that CIFNET trainees have to wait for 2-3 years for getting a posting for acquiring sea service. Fishing Industry at the same time struggles with the few eligible certificated hands to man their vessels which is evident from the pressure of increasing number of private candidates manning the fishing vessels with a partially passed competency certificate issued by MMD.

Fishermen Training Centres

Training to the traditional sector is imparted by the various Maritime States themselves through their training centres. Fisheries departments of State/U.T. Governments have established Fishermen Training Centres in certain coastal districts to train fishermen in modern fishing techniques. The nine maritime States and three Union Territories are equipped with an estimated 50 Fishermen Training Centres (FTCs) functioning with 200 training officers. These training officers are deputed from time to time to undergo various refresher courses. Upgradation courses are conducted by CIFNET for the benefit of the trainers at these training centres. Of late, the number of trainees deputed by the state fisheries departments has come down, though there is a consistent need expressed by them for conducting such refresher courses which is evident from the particulars given in Table 3. The state of affairs of the programme is thus is very disappointing and the fisheries operatives training programme as at present is in doldrums.

Fisheries in the 10th Plan

The nation is all set to enter into the 10th Plan with a reformative economic approach as globalisation process and market oriented activities are on. Schemes and projects in the fisheries sector focusing priorities and need of the present and future have been projected as part of the plan.

Working group on fisheries is very specific in respect of introduction of schemes for the exploitation of the untapped oceanic fishery resources like tuna, and also the deep-sea lobster resources.

Indian marine fishing industry in line with the above approach is already on the threshold of diversifying its activities for exploiting the untapped oceanic resources of Indian EEZ. The pilot project for the conversion and experimental operation of two of the shrimp trawlers of the industry for undertaking monofilament tuna long lining is in its final stage of implementation.

Emphasis is also likely in regard to the strengthening of aritisanal and traditional sector in the 10th Plan. This will mean more mechanisation and motorisation and upgradation of smaller and intermediate crafts. The scope and need to justify the training requirements for this sector are already in focus.

, Manning rules of fishing vessels operatives have undergone certain changes in accordance with M.S.Act 1995 these are given in Table 7.

As may be seen, vessels below 20m. OAL (which were earlier manned by a Skipper Grade I) can now be manned by less competent personnel. As estimate shows that vessels in the range of approx. 15-17 m OAL may be as many as 500 nos on the east coast and about the same on the west coast also. These vessels which operate in deep sea zone are equipped with sophisticated machinery and equipment. At present, the man-

Table 7 : Manning rules M.S.Act 1995

Size/power of fishing vessel	Area of operation	Requirements of certified Personnel
i) Deck side		
a) 24 m. or over	Beyond contiguous zone	Skipper Grade I & Mate(FV)
b) 24 m. or over	Within congiguous zone	Skipper Grade II & Mate(FV)
c) less than 24 m.	Within contiguous zone	Skipper Grade II
ii) Engine side		
a) 750 KW or more	-	One Engineer of Fishing Vessel and one Engine Driver (FV)
b) 350 KW or more but less than 750 KW	-	One Engineer of Fishing Vessel
c) Less than 350 KW	-	One Engine Driver of Fishing Vessel

ning personnel on board these vessels have limitations in training. The owners of these intermediate crafts are also planning to diversify their operations by installing monofilament tuna long lining equipment which warrants specialised training. This trend clearly shows that programmes for the manning personnel of this category need special attention.

International convention on Standards of Training certification and watch keeping for fishing vessels personnel (STCW-F) formulated by IMO envisages a wide spectrum of training programmes to personnel manning fishing vessels including deckhands on board a fishing vessel of 24 m LoA and above. Taking cognizance of the findings of this august body, all existing training programmes require a thoughtful reorientation to conform to international standards. Introduction of new programmes of training in areas hitherto not covered adopting international standards is also an immediate need.

Fishing Vessel Operatives Training Programme for the Future

Fishing vessel operatives training has not been receiving the attention that it diserves and this is a matter of concern. Training is an amalgamation of education and its practical applicability. Reorienting the training programmes of fishing vessel operatives at national level, keeping this concept in view, there is an urgent need to restore the lifeline of Indian marine fisheries as indicated hareunder.

Traditional Marine Fishing Sector: 1) Improvements contemplated in the artisanal and traditional fishing fleet of the country can be sustained only by imparting the technical know-how of operations to the operatives. To achieve this goal, theoretical courses for Master fishermen for a duration of 3-6 months to this category of personnel to man these vessels may be introduced on a priority basis; 2) Activities of fishermen training centres have to be streamlined for imparting meaningful and need-based training to the artisanal/traditional sector.

Marine Fishery Industrial Sector: 1) The organised training imparted to the operatives of this sector extended by CIFNET has lacunae as explained in the foregoing account. Strengthening these training programmes with is essential to bring about standardisation of these programmes by way of a) adding new multi-type training vessels have to be added to the training fleet of the country with immediate effect; b) The private industrial fishing fleet has to shoulder the responsibility of providing trainee berths for atleast one CIFNET trainee per vessel to enable them to acquire sea service and to serve the fishery industry; c) Indian Skippers and Fishing Vessel Engineers are accepted internationally and enjoy good reputation. At the same time, it is now time to equip the candidates to face the difficult scenario that is in the offing and will materialise in the coming years. To conform with the ten standards of IMO and to compete in a global set up it is expedient to produce competent Skippers and Fishing Vessel Engineers to withstand and measure up to the skills needed to man national vessels and to participate in the international arena.

General

The fisheries administrative set up of the country is so designed that the Fishing Vessel Operative training in the country is bifurcated arbitrarily and implemented by various maritime states and the centre on parallel lines. For this reason, meaningful co-ordination and monitoring is lacking in the present day context which has been affecting the quality of training adversely. In this situation, the entire fishing vessel operatives training of the country has to be taken over and implemented under the banner of CIFNET and controlled and monitored by a Technical Head of the Department at ministry level. With such a reform and adoption of a unified policy for fisheries operative training the quality of training can be improved in a manner that would come up to the level of international standards. CIFNET has the capability but needs to be strengthened to meet the challenge of piloting the training programmes to produce the kind of fishing vessels operatives needed to meet the challenge of the vessel manning requirements of the future.

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Demonstration-cum-Workshop on the Operation of TED

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nology to be a long range process to suit to the needs of local fishing.

4) Tagging and Telemetric methods are to be adopted by NRSA and WII.

5) Collection of data on incidental mortality of turtles all along coast, computerization of the same and comparing it with the base line data to be undertaken. Evaluation is to be done every year by the apex team for disseminating the same among all concerned.

6) Based on Evaluation, Intermediary meetings of all departmental officials involved are to be conducted to revalidate the effectiveness of the plan.

7) Research on TED designs to be conducted by CIFT.

8) Funding by concerned agency throughout the action plan period is necessary.

9) Study tour of SIFT faculty to Gaharimata is to be arranged to study different aspects of turtle conservation.

10) TED-Information Centre of SIFT may act as Nodal Monitoring and Information Centre.

11) Training to faculty of SIFT on conservation of sea turtles to be given at Orissa coast and on design of TED at

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Unemployment and Labour Redeployment among Trawler Workers during Trawl Ban Period

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The 45 day trawl ban during monsoon season affects nearly 30,000 labourers working in 5,000 mechanised crafts (small trawlers) in Kerala. They are either alternatively employed (in the traditional sector or otherwise) or are unemployed during the period. It was observed that unemployment levels of the trawler workers are high during the ban period in Munambam and Ponnami, two of the major fishing centres studied. Only a quarter of the total work force in trawlers could find alternative employment. Labour movement towards grounds closer to their homes was also observed. In Ponnani, very few shifted to the traditional sector. Although the percentage of redeployment of trawler workers to traditional crafts is very low, from the observations made during Chakara [at Puthenkadapuram (Malappuram) and Koorikuzhi (Thrissur)], it was found that there was redeployment of trawler workers on mini trawlers, large plank built crafts and small plank built crafts. Less than 30 per cent of the respondents favoured the imposition of the ban, because of economic and livelihood considerations.

Mechanisation of fishing vessels in the late 1950s was probably the most important milestone in the developmental history of Kerala fisheries. By the mid 1960s mechanisation picked up and small trawlers started operating. The 'modernisation/growth oriented model' was also supported by measures from the Government (Kurien & Achari, 1990). The obvious technological differences between the traditional and mechanised sectors brought about a disparity in the wealth distribution leading to a growing rift between the two sectors (Chandran, 1990). Regulation of some sort was initiated for the first time in the country through introduction of the Kerala Marine Fishing Regulation Act (1980). Besides registration and licensing of boats, regulation of mesh size of nets, prohibition of certain fishing methods and delimitation of fishing zones, declaration of closed season (Anon, 1891) were also provided for, in the Act. This aspect of closed season was later studied by various expert committees appointed by the Government of Kerala (Kalawar *et.al.,* 1985; Nair, 1989). On the basis of their recommendations, a partial ban on trawling during monsoon season with minor variations has been in place since 1988.

The Study

The monsoon trawl ban imposed by the Government of Kerala for the past ten years affects nearly 30,000 labourers working in 5,000 mechanised fishing crafts. They are either unemployed during the period or do odd jobs. Results of investigation on the nature and extent of unemployment in the mechanised sector during the ban period is dealt with in this paper. One observation is that some labourers from the mechanised sector migrate to the traditional sector during the ban and return to work on to mechanised fishing boats soon after it is lifted. In view of this, this study also probes the extent of this redeployment. An attempt is also made to quantify the attitude of the trawler workers towards the imposition of the ban.

Data were collected during the 45 day ban period of 1999 from individuals (labourers in both traditional and mechanised sectors) at major landing centres from Ponnani to Alappuzha through interview method.

Observations

It was observed that unemployment levels of the trawler workers were high during the ban period in two of the major fishing centres studied, Munambam and Ponnani (Table 1). Only a quarter of the total work force in trawlers were alternatively employed during this period. In Munambam, of the total number of workers who would work elsewhere during the ban period, 70 per cent were from Colachal in Tamil Nadu, temporarily migrating to their native fishing villages. The remaining 30 per cent, from nighbouring places (like Alappuzha, Karunagapally, Azhikode, Malliankara, Paravur etc.) also would go back to their respective villages for working in traditional crafts, or would engage themselves in related activities.

Table 1: Extent of unemployment and labour redeployment/alternatively employed in Munambam and Ponnani during trawl ban

Particulars	*Munambam harbour*	*Ponnani harbour*	*Total*
Number of mechanised crafts	450	300	750
Number of labourers employed	2700	1800	4500
Number of labourers redeployed or alternatively employed during ban period	700	400	1100
Percentage of redeployment/ alternative employment	25.93	22.22	24.44
Unemployment during ban	74.07	77.78	75.56

What was clear from the observations at Munambam was that there was labour movement towards home grounds in search of employment. In Ponnani, on the other hand, although the percentage of those redeployed or alternatively employed was 22 per cent, very few shifted to the traditional sector. They usually opted for manual labour and other jobs. The exact nature of empolyment in both these centres could not be ascertained from the data obtained.

The study has revealed that maintenance and repair of trawlers is undertaken during the ban period. It was observed that among the 3,400 workers unemployed, 20 per cent took care of the maintenance, repair and upkeep of crafts. This cannot be taken as a form of employment since the working arrangements were temporary and the wage rate varied.

Table 2 shows the extent of redeployment in Thrissur, Alappuzha and Malappuram districts.

It is seen form the results that Thrissur accounted for the highest redeployment rate of 45%. In Alappuzha, it was 2% and in Malappuram 0.73%. The percentage of Thrissur is aggrandised because of the data from Azhikode-Eriya belt. The observations on traditional craft landings across nine centres in this belt revealed that a number of redeployed trawler workers were from Alappuzha rather than from Thrissur.

Although the percentage of redeployment of trawler workers to traditional crafts is very low, from the observations during *Chakara* at Puthenkadapuram (Malappuram) and Koorikuzhi (Thrissur) it was seen that atleast 3 labourers out of 12 in *murivalloms* (mini trawlers) were redeployed trawler workers (making the redeployment as high as 24%). Labourers were also redeployed on large plank built crafts and small plank built crafts operating ring seines for sardine/mackerel and anchovies respectively. The crew size attached to these crafts goes up during the ban period due to this redeployment. Studies have revealed that in Cochin region 80-85 fishermen (including the fishermen on shore who help in launching the craft and who take turns to go to sea the next day) are attached to a ring seine unit during the season (Leela Edwin, 1997).

Less than 30 per cent of the respondents favoured the imposition of the ban as can be observed from Table 3. Economic and livelihood considerations tend to influence the attitude of workers towards the ban. Though this period offers a respite from the gruelling nature of the job, unless alternative employment is easy to find, there will be resistance to the imposition of the ban.

Conclusion

Regulations in respect of fishing activity, due to increasing discord between the traditional and mechanised sectors, led to the imposition of partial ban on trawling during the monsoon season. This ban affects nearly 30,000 labourers working in 5,000 mechanised craft. The study has shown that unemployment levels of the trawler workers are high during the ban period in two of the major fishing centres studied, Munambam and Ponnani. In Munambam, only a quarter of the total work force in trawlers is alternatively employed during this period. Labour from Colachal (Tamil Nadu) and Alappuzha, Karunagapally, Azhikode, Maliankara and Paravur (Kerala) move towards home grounds in search of employment, largely in the traditional sector. In Ponnani, on the other hand, very few of redeployed/alternatively employed workers shift to the traditional sector, opting instead for manual labour and other jobs. It is seen from the results that Thrissur accounted for the highest redeployment rate followed by Alappuzha and Malappuram. It was however observed that during *Chakara* at Puthenkadapuram (Malappuram) and Koorikuzhi (Thrissur) at least three labourers out of 12 in *murivalloms* (mini trawlers) were redeployed trawler workers. Labourers were also redeployed on large and small plank built crafts operating ring seines for sardine mackerel and anchovies respectively. The number of crew attached to these crafts would go up during the

Table 2: Extent of labour redeployment from mechanised sector to the traditional sector during trawl ban in Alappuzha, Thrissur & Malappuram

No.	*Landing Centre*	*Total no. of labourers in traditional sector*	*No. of redeployment labourers*	*% of redeployment*
Alappuzha				
1	Kakkazham	8950	150	1.67
2	Chenangara to	3175	150	4.72
	Purakkad			
3	Chetti	605	10	1.65
	All Centres	*12730*	*310*	*2.43*
Thrissur				
1	Nattika	345	3	0.86
2	Koorikuzhi	1100	30	2.72
3	Eriyad-Azhikode	1770	100	5.64
	All Centres	*3275*	*150*	*4.58*
Malappuram				
1	Marakkadavu	1220	15	1.23
2	Veliyankode	245	-	-
3	Puthenkadappuram	1250	5	0.4
	All Centres	*2715*	*20*	*0.73*

Table 3: Attitude of trawler workers towards trawl ban

Attitude	*Alappuzha*	*Thrissur-Malappuram*
	Mean	Mean
Favourable to imposition of ban	27.7 (1.33)	22.03 (4.11)

(Standard Deviation in parenthesis)

ban period due to this redeployment. Less than 30 per cent of the respondents favoured the imposition of the ban, unemployment being one of the major reasons for their negative attitude.

Alternative fishing methods, although sound viable, are not a practical proposition since the sea is turbulent during this season and passive gears like gill nets cannot be operated. However, it was observed in some aras that small meshed gill nets (sardine gill nets and mackerel gill nets) were being used as encircling gear from the shore (operated similar to shore seines). If such innovative ideas are put to wider practice there will be possibilities of employment.

In this context, it is suggested that the government should take steps towards:

1) installation of FADs (Fish Aggregating Devices) in conducive areas; 2) Promotion of sea farming, cage culture practices, aquaculture practices etc., and 3) Encouraging allied jobs like net making and mending, engine repair and craft maintenance.

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CIFT, Cochin.

12) Research on probes for identification of entry of turtles in trawl nets to be done by WII and NRSA.

13) Periodic trial netting with new designs of TED need to experimented in order to decide its effiency.

Community based Conservation

1. SIFT should take a vital role in bringing about awareness and co-ordination among all the stake holders viz., NGOs, fisherfolk and forest department.

2. Awareness programmes should be conducted throughout the A.P. coastline in respect of conservation of turtles.

3. For popularisation of TEDs awareness at all fishing harbours of A.P. is necessary to safeguard the interests of fisherfolk.

4. Regional level Workshops may be organised to enable all concerned to develop a better understanding about conservation of sea turtles, with reference to differing fishing activities from region to region.

5. Forest department officials should take all needed steps to see that volunteers of VSS also join hands for achieving the noble objective of turtle conservation.

6. Awareness among fisher children regarding conservation can be initiated at school level itself by arranging competitions, debates, painting, poster making etc.

7. Sea Turtle Conservation messages may be disseminated among the coastal communities through plays, skits, folk songs, dramas and display of placards, and organising rallies, displaying posters etc.

8. Formation of 'Turtle Clubs' at village level may be taken up and the best club may be given incentives.

There was distribution of mementoes to the Resource Persons and to the Officers of the Head Office of Fisheries Department. The Workshop ended with a vote of thanks by Mr.M.A.Yakub Basha, Assistant Director of Fisheries, SIFT, Kakinada, who profusely thanked the dignitaries and other participants for making the Workshop a thumping success.

Import of Nile Tilapia : Ban partly lifted

It is learnt that the Government of India has lifted the ban on import of Nile Tilapia (*Tilapia nilotica*) in favour of Water Base Ltd and another South Indian Company. This development is interpreted in two ways: i) These two companies will have monopoly over the production of nile tilapia seed, in all likelihood, in mono-sex form. The seed of this fish is likely to pick up demand, once its seed production and polyculture with shrimp or for monoculture picks up, and 2) the partial lifting of the ban may eventually prove to be providing a spread effect for the benefit of the industry.

OBITUARY

Sudden demise of S. Paul

We regret to report the sudden death of Mr. S. Paul, Senior Scientist (Retd.) of CICFRI, on the night of 28th April 2002 at Barrackpore. He was on a visit to the place to participate in a symposium at CICFRI. His sudden demise came as a great shock to the participants at the Symposium. A condolence resolution was passed and conveyed to the bereaved family.

Karnataka Newsletter

From : **H.N.Chandrasekhariah**

H.S. Veerappa Gowda takes over as Director of Fisheries, Karnataka

H.S. Veerappa Gowda, Joint Director of Fisheries (Inland), in Karnataka Fisheries Department took over as the Director of Fisheries of the State from Mr. D.M.A. Hameed who proceeded on voluntary retirement from 1st March 2002.

Veerappa Gowda hails from Huruli Village, Shimoga District. He is an M.F.Sc. degree holder from the College of Fisheries, Mangalore, obtained in 1983.

After obtaining his Master Degree he began his carreer as Technical Assistant under Pollution Monitoring Scheme and later as an Instructor in the Department of Fish Processing Technology, in the College of Fisheries, Mangalore during 1983 to 1985.

Thereafter, he Joined the State Department of Fisheries, Karnataka, as Assistant Director of Fisheries, Bhadra Project and later gained experience under the Indo-Danish Fisheries Project at Tadri, in the capacity of General Manager of two associated Fisheries Co-op Societies. Later he served successively as Senior Assistant Director of Fisheries and Deputy Director of Fisheries with distinction. He was promoted as Joint Director of Fisheries in 1997, and in that cadre functioned as Project Co-ordinator, Malpe and Honnovar Fishing Harbour Project before joining the Directorate as Joint Director of Fisheries (Inland) in 2000.

With his experience both in Marine and Inland Fisheries development, Mr. Veerappa Gowda has now the opportunity to provide a major fillip to the integrated growth of marine capture fisheries and the culture fishery sector of the State in a manner that would improve the 'socio-economic' conditions of fishermen, upgrade the fishery industrial sector, and augument supplies of fish to the people and also strengthen facilities for export of marine products.

Fishing Chimes congratulates Mr. H.S. Veerappa Gowda on his assumption of office as the Director of Fisheries, Karnataka.

N. Nanjegowda elected as Chairman, Karnataka Co-Operative Fisheries Federation, Mysore

Mr. N. Nanjegowda has been elected as The Chairman of Karnataka Co-operative Fisheries Federation, Mysore, for the second term. His deep interest in aquaculture and the remarkable work done by him as the President of the Mandya District Fish Growers Federation from 1993 to 1997 led to his success in aquaculture sector. During this period (1993-97) he developed fisheries in irrigation tanks and achieved record inland fish production. He has the distinction of organising intensive stocking of fish seed in all the tanks of Mandya district, and augmenting fish production, thereby launching blue revolution in the District during his presidentship. This exemplary work became an eye opener for those in the neighbouring districts. He took keen interest in promoting systematic exploitation of fisheries of medium reservoirs in Mysore district i.e., Gundal and Suvarnavathi Reservoirs through participation of Scheduled Castes and Soliga communities, and he was responsible for realisation of high incomes by these communities in the district. There are two other aspects to his credit, one is demonstration of high fish harvest in No-navinakere tank in Tumkur District, and the other is organisation of a Fishery Field day at Thonnur Tank, Pandavapura Taluk during 1993-'94. On that day five tonnes of fish were harvested from the Tank, each weighing 10 to 15 kg, and this achievement was due to his organisational skills.

He has the credit of being elected a member of Mandya Zilla Panchayath right from the time Panchayath institutions commenced functioning in the State. His efforts enabled the release o Rs.10 lakhs from the Chief Minister fund for the fishermen who suffered great loss on account of mass mortality of fish in Enne hole tank.

It is anticipated that the Fisherie Federation will extend its activities t Shimoga, Dharwar, and Raichur districts and organise development of Fisheries in irrigation tanks through fisher men Co-operative societies with an as sistance of Rs.13 crores from N.C.D.C

Fishing Chimes wishes all success t Mr. Nanjegowda in his endeavours.

Directorate of Fisheries to shift from Bangalore to Mangalore

Orders have been issued by the Gov ernment of Karnataka to shift the hea quarters of the Directorate of Fisherie from Bangalore to Mangalore.

This order is in confirmation of th Chief Minister's announcement in hi budget speech (2000-2001) stating tha the Directorate of Fisheries would b shifted to Mangalore to give impetus t marine fisheries activities. The need t diversify the activity and to step up com mercial exploitation of rich marine re sources of the State has been also th objective behind the proposal.

The Government has also sanctione Rs.65 lakhs towards meeting the cost transportation of furniture, renovation Mangalore Municipal Corporatio building near Lady Hill to house the D rectorate of Fisheries, besides the ex penses to be incurred on officials to b transferred etc. Government has permi ted to retain a nucleus staff at Bang lore to work in the Liaison office.

The decision was delayed as there was lot of opposition to the shifting for the reason that much of the work revolved around the problem of development of Inland Fisheries, which is complicated and spread over 24 districts out of 27 districts of the State, and Bangalore is central to promote the activity.

Another aspect pointed out was that the Directorate should interact with other development departments which are situated in Bangalore, besides pursuing matters relating to Fisheries, Planning, and Finance Departments at Government level and also to facilitate meetings with the Minister for fisheries to discuss and take orders on important matters.

The budget sub-committee constituted by the Government of Karnataka for the year 2001-'02 headed by Mr. C. Byregowda, M.L.A. and former Minister for Fisheries and Ports had recommended for the continuation of the Directorate of Fisheries at Bangalore, after considering several aspects of the issue.

More than 150 Inland Fishermen Co-operatives had also requested the Government to retain the Directorate at Bangalore on the plea that it will be inconvenient for their representatives to go over to Mangalore to meet the Director to represent the problems that arise from to time.

Apparently, Government are not convinced on any of these appeals and representations. It is to be seen how the Government will avail of the services of the Director of Fisheries with his headquarters at Mangalore for the development of inland fisheries in the State which has the potentiality of producing about 4.0 lakh tonnes of freshwater fish annually.

Arther D' Casta is the new Chairman of K.F.D.C. Mangalore

The Government of Karnataka has appointed Mr. Arther D' Casta of Shimoga district as the Chairman of Karnataka Fisheries Development Corporation Ltd. in place of Mr. B. Ramanatha Rai, Minister for Fisheries, Ports and Area Development.

It is expected that the new Chairman will revive the Corporation which is on the brink of closure.

Training in Freshwater Prawn Farming

A five day training programme was organised by the Fisheries Research Station, University of Agricultural Sciences, Bangalore in collaboration with Department of Fisheries, Government of Karnataka from 21-25 Feb.2002 . The programme was inaugurated by Dr. K.V. Devaraj, former Vice-Chancellor of University of Agricultural Sciences, Bangalore. In his inaugural address Devaraj highlighted the growth and production of giant freshwater prawn in the country and informed the trainees to understand the different steps of scientific prawn farming clearly and achieve sustainability in prawn production. Dr. C. Vasudevappa, Course Director and Fisheries Research Officer & Head, Fisheries Research Station, Hesaraghatta explained the need of scientific prawn farming and gave details of the programme to be conducted over 5 days. 20 fish farmers and 5 Officers of Department of Fisheries from all over the State participated in attended the programme.

Mr. Veerappa Gowda, Joint Director of Fisheries, Govt. of Karnataka at the time (now Director of Fisheries) called upon the fish farmers and officers to promote freshwater prawn farming on a viable basis utilising various schemes and programmes of Department of Fisheries. Dr. A.M. Krishnappa, Vice-chancellor, University of Agricultural Sciences, Bangalore in his presidential remarks highlighted the need for this training to update the knowledge base. He exhorted the trainees to acquire the best technology through continuous interaction with the scientists and officers and make prawn farming a viable proposition. Dr. Y. Basavaraju welcomed the participants. Dr. D. Seenappa was the master of ceremonies. Dr. Challaiah, Extension Co-ordinator proposed a vote of thanks.

During these five days, the trainees were told about the various aspects of freshwater prawn farming through a series of lectures viz., on present status and scope, biology, production technologies, feeds and feeding, water and soil quality management, diseases and their control, schemes and programmes of Department of Fisheries, role of financing institutions and extension approaches for popularisation of technology. The trainees were also taken to a nearby prawn farm at which they interacted with the owning farmer on management of prawn farm. The participants were also given practical training on preparation of good quality pelleted feed and told about the importance of on-farm feed preparation for freshwater prawn farming.

On the concluding day, Mr. Abdul Hameed, the then Director of Fisheries, Department of Fisheries, Govt. of Karnataka distributed the certificates to the participants. He emphasised the importance of revival of the programme for the benefit of the farmers and the State.

Foundation Stone laid for Rs. 20 Lakhs Building for Establishing Awareness Centre

Mr. B.Ramanatha Rai, Minister for Fisheries Ports and Area Development laid the foundation stone on 17.3.2002 for the construction of a building at a cost of Rs. 20 lakhs at Mangalore Fishing Harbour to house the Awareness Centre and also inaugurated the "Concrete Road" at the fishing harbour laid at a cost of Rs. 7 lakhs.

The minister said that adquate attention had been given to create infrastructure facilities for marine fisheries development. Construction of jetties, minor and major harbours and establishing preservation and processing facilities at the landing centres have facilitated fishermen to get remunerative prices for their catch. He said that the construction of II Phase Fishing Harbour at Malpe was almost completed, and that the construction of Gangolli Fishing Harbour would commence shortly. The Fishing harbours at Mangalore and Karwar were being expanded. He also announced that Rs. 36 lakhs were sanctioned for the construction of sea wall at

Hoige Bazar, Mangalore to prevent sea erosion.

The Minister said that subsidy on sales tax on diesel consumed by fishing vessels would be continued for the year 2002-2003.

It was observed by him that the poor fish catches were attributable to the operation of *Matabale* during closed season i.e., monsoon. He said that proper vigil would be enforced to prevent such fishing activity during monsoon. It was mentioned that houseless fishermen were being identified and they would be provided with free houses constructed out of National Welfare Scheme. The Minister distributed distress relief cheques to individuals on the occasion.

The "Awareness Centre" is proposed to be extablished at a cost of Rs. 20 lakhs at Mangalore fishing harbour under the Centrally sponsored Scheme. 80% of the cost shall be borne by Govt. of India and 20% by State Govt. The awareness centre will be equipped with Satellite-linked forecasting system for locating potential fishing grounds, for information on weather conditions etc. with fax, and other modern equipments. The centre would also be the converging and disseminating point in respect of information of interest to fishermen, such as schemes for which NCDC and NABARD provide assistance, and safety measures to be followed in sea during fishing. It will also provide Radio Telephone facilities from shore to deep sea fishing vessels, fish market prices, and wharfage details. A museum of traditional fishing gears and crafts would also be established, besides displaying preserved marine fish species of Karnataka. The centre would also be equipped for holding conferences and for other useful purposes.

Mr. Abdul Azeez, Mayor, Mangalore city corporation, presided over the function. Mr. Yogesh Bhat, M.L.A. and Mr. Abdul Hakeem, corporator, were Chief guests. Mr. Shashidhar Hagde, Executive Engineer, Port Division and a large number of fishermen attended the function.

Earlier, Mr. Vichitrakumar Shetty, Deputy Director of Fisheries, Mangalore welcomed the distinquished guests and participants.

Rs. 2,830 lakhs Budget for Fisheries Development

Government of Karnataka has provided Rs. 2,830.13 lakhs for the year 2002-2003 for fisheries development in the State.

The budget particulars for the last three years are furnished here-under:-

Year	Plan		Non- Plan		Total	
	Budget	Expdr.	Budget	Expdr.	Budget	Expdr.
1999-2000	2378.40	2051.37	993.29	850.69	3371.69	2903.06
2000-01	2067.74	1503.82	1126.79	1101.35	3194.53	2605.17
2001-02	2283.96	1747.22	1680.82	1145.91	3964.78	2893.13
2002-03	1656.44	-	1173.71	-	2830.15	-

As could be seen, the budget provided for fisheries development is being gradually reduced year after year. However, Minister for fisheries, when questioned about the reduced budget, said that the tempo of fisheries development shall be maintained availing of Rs. 10 crores for improvement of Government Fish Seed Forms for augmenting quality fish seed production. Further Rs. 13 crores assistance, would be obtained from NCDC for the Development of Fisheries in irrigation tanks through Fisheries Co-operatives. He also said that subsidy on sales tax on diesel shall be continued for the year 2002-03.

Important schemes along with Budget allocation are as follows:

1. Rs. 315 Lakhs are set apart for the construction, improvement of Fishing Harbours, Jetties and Landing centres.
2. Rs. 350 lakhs for development of model fisher villages.
3. Rs. 109 lakhs are towards group insurance scheme and savings cun relief scheme for marine fishermen.
4. Rs.64 lakhs for the welfare schemes for fishermen belonging to scheduled castes and tribes.
5. Rs. 30 lakhs for link roads, bridges and Jetties under infrastructure development, with NABARD assistance.
6. Rs. 75 lakhs for implementing Inland and Marine fisheries project with NCDC assistance.
7. Rs. 34 lakhs for fish seed production rearing and distribution.
8. Rs. 23 lakhs for research, education training and extension programmes
9. Rs. 19 lakhs for providing subsidy for the construction of fish culture ponds in saline soils and in other areas.
10. Rs. 11 lakhs for the establishment of aquaria and their maintenance.
11. Rs. 11 lakhs towards subsidy for motorisation of Traditional Craft and acquiring fish finders, radio telephone etc. by deep sea fishing vessels.

The marine fishermen say that they are very much disappointed as no relief to fishermen is announced in the State Budget to compensate for poor catches and hardships faced by them.

Porpoise weighing 200 kg caught

A porpoise weighing 200 kg was caught by Ganapathi Taku Harikantra on 1.4.2002 while operating his trawler off Karwar coast.

While two porpoises were caught in the Trawlnet, one escaped leaving the other. The landed porpoise was 7.9 ft long and 2.8 ft. wide.

It is reported that porpoise shoals are seen often along Karwar coast but seldom caught.

Writ petitions filed against shifting of Directorate of Fisheries from Bangalore to Mangalore

Two writ petitions were filed in the High court of Karnataka by Fishermen Co-operative Societies challenging the Govt. orders to shift the headquarters of Directorate of Fisheries from Bangalore to Mangalore.

The backward class and Dalit Association appealed to the Government for the retention of Directorate of Fisheries at Bangalore to protect the interest of poverty stricken inland fishermen also spread over in 24 districts of the State.

West Bengal Newsletter

From : P.K. Samanta

Exemplary Kiranmay Nanda, West Bengal's Fisheries Minister

——Indian Fisheries Sector's Pride, with Record-breaking Tenure

Among Fisheries Ministers, Mr. Kiranmay Nanda is the crowning glory not only of India's fisheries scenario but of global fisheries history itself. He has the unique and unparalleled distinction of being the Minister for Fisheries of West Bengal for 23 years and well set on the innings, by dint of his dedicated and selfless service to the fisheries sector of the State of West Bengal. Evolving and implementing forward - looking policies, he has endeared himself to the fishermen and fisheries entreprenuership. Fisheries Development in West Bengal made rapid strides all these years under his dynamic and inspiring leadership.

The publication of *Fishing Chimes* started in the second year of his fisheries ministership, with his blessings, owing to which the journal picked up in its pace. It continues and progresses.

Kiranmay Nanda, son of respected Sanskrit teacher Late Jyotirmay Nanda and grandson of highly philanthropic zamindar, Late Gangadhar Nanda of Vill.- Mugberia, Dist.- Midnapore, W.B. assumed the office as Minister-in-charge for Fisheries of West Bengal during 1979-80. As Fisheries Minister, Mr. Nanda has been providing purposeful and dynamic leadership which has motivated the technical officers and other employees of the State Fisheries Department to perform well in their area of work for the advancement and prosperity of the State Fisheries Sector. Of late, with active intervention of the Fisheries Minister, the Government of West Bengal has redesignated the Department of Fisheries as "Fisheries, Aquaculture, Aquatic Resources & Fishing Harbours Department". Enriched by experience gained over years, he has streamlined the working of the Fisheries Department in a manner that has upgraded Fisheries management strategies of the State in a resolute way. Encouraged by the cooperation extended by all concerned and the successful results, Kiranmay Nanda now functions with a new, elevated and objective vision fortified by an ardent zeal.

It is significant that Kiranmay Nanda ushered in fisheries development in the State in a specific manner with a long range objective. He introduced various fisheries development projects which have been yielding excellent results.

In fact, on account of the sustained efforts and strategy of the Fisheries Minister and active participation of the fish farmers, fish seed production and culture fish production of, the State has made considerable progress over the successive Five Year Plan periods. It was under his leadership West Bengal achieved the status of one of the progressive marine fish producing states, with a large number of mechanised fishing boats operating. Earlier, the State was considered to be weak in marine fish production. In recognition of such remarkable achievement, Kiranmay Nanda won the distinction of receiving the best Fish Productivity Awards in the country for the last 10 consecutive years with an incremental growth rate of 9.3 percent compared to 4.3 percent at national level.

While the sixth five-year plan was the turning point in the development of fisheries in West Bengal, the ninth five-year plan has been the zenith of achievement under his leadership, in terms of consolidation of the gains till then. Recorded information collected from different sources indicate that fish production of West Bengal has zoomed from 3.74 lakh tonnes in 1980-81 to 10.6 lakh tonnes in 2000-2001, registering an annual growth rate of 9.32%. The data indicate that the production of fish seed at the end of fourth year of ninth five year plan was 8850 million nos which was about 75% of the total production of fish seed in the country.

It has been initially estimated by the State Fisheries Department that at the begining of the tenth five year plan, the demand for fish in the State would be 11.68 lakh tonnes and production would be 11.30 lakh tonnes. However, based on a fresh assessment, the demand for fish at the end of 10th plan has been placed at approximately 12.51 lakh tonnes and accordingly the target of fish production at the end of 10th plan is being refixed at the same level.

With regard to research activities, at the initiative of the Minister, the Department of Fisheries has set up and strengthened a Research Centre on Fish Microbiology and Parasitology at Captain Bhery, Kolkata for evolving remedial measures in respect of finfish and shellfish diseases.

An outstanding contribution of Kiranmay Nanda was the establishment of the West Bengal University of Animal and Fishery Sciences during the year 1995-96. Under the University, the Faculty of Fishery Sciences now conducts a 4 years B.F.Sc course and 2 years M.F.Sc curse

Information gathered from the Directorate of Fisheries, West Bengal indicates that Kiranmay Nanda has taken up various development programmes which include fish seed production, integrated in-

land fisheries project, *Jhora* and *beel* fisheries development and co-operatives, River ranching, brackishwater aquaculture, social fishery, marine fishery development, introduction of patrol boats, application of remote sensing in marine fisheries, expanding welfare measures, research activities, training, extension and education, Farm utilisation, and augmenting export of marine products etc.

Highlights of the achievements at a glance in different discipline of Fisheries in West Bengal, both Inland and Marine under Kiranmay Nanda's stewardship are as follows:

Tenth Five Year Plan Objectives (Proposed)

Thrust Area for Xth Five-Year Plan for the State of West Bengal

1. Resource development and enhancement of fish production through reclamation of *beels/ baors/bandals*/reservoirs with the aim of attaining self-sufficiency. Implementation of schemes on ornamental fishery/crab culture involving.
2. Employment generation,poverty alleviation and upliftment of rural economy through different developmental programmes.
3. Special emphasis with regard to upliftment of socio-economic condition of SCs and STs.
4. Provision of welfare measures for the fisher community.
5. Establishment of a further number of fishing harbours & fish landing centres, strengthening and maintenance of existing minor fishing harbours and fish landing centres for having more berthing & shore base facilities.
6. Dredging of Minor Fishing Harbours ~ Digha Stage- I & II & Fresergaunj & provision for operation of such harbours which will be coming up.
7. Management, control & surveillance under marine sector.
8. Installation of artificial reefs.
9. Optimum utilisation of marine resources through setting up of Remote sensing Devices with wireless communication system & potential fishing zone forecast; Introduction of combination vessel / multipurpose vessels for utilisation of trash fish.
10. Development of infrastructural facilities like link roads, fish markets, processing centres, ice plants, etc.
11. Strengthening of Research & Developmental activities.
12. Setting up of Database System & development of computer network.
13. Protection of Aquatic ecosystem.
14. Development of fishery co-operatives.
15. Welfare measures.
16. Strengthening of administrative set up.

Achievement Report in Respect of Different Schemes initiated by the Fisheries Minister of West Bengal, Mr. Kiranmay Nanda

S.No. (1)	*Item/Name of the scheme* (2)	*Since 1982-83 upto 2000-01* (3)	
1.	Old age pension for fishermen	1500 fishermen executed since 1990-91	
2.	Social Fishery	10284.82 ha. brought under fish culture since 1997-98	
3.	River Ranching	160.00 lakh fingerlings liberated in the tributaries of Bhagirathi since 1992-93	
4.	Introduction of Fishing boats in marine sector with ARDC/NCDC assistance	4272 mechanised fishing boats and 4850 traditional boats (motorised) introduced Since 1982-83	
5.	Fishing Harbours	3 (Digha stage-I and II and Fresergunj)	
		2 (Kakdwip and Sultanpur approved)	
6.	Fish Landing Centers	12	
7.	Marketing Infrastructure	Ice plant (20 mt)	-2
		Insulated Van (3 mt)	-8
		Kiosk	-22
		Cold Storages (10 mt & 25 mt)	-2
		Central Processing Plant	-1
		Fish handling shed	-6
8.	Other infrastructure	i. Barge Jetty (over the river Hatania Doania at Namkhana, South 24 Pgs.)	-1
		ii. Boat Building yard	-7 Nos.
		iii. Net making/mending shed	-7 Nos.
		iv. Tubewells	-408 Nos
		v. Village Road development	-1380 KM
		vi. Community Hall	-63 Nos
		vii. Auditorium	-2 Nos
		viii. Distress shed	-11 Nos

18. Fish seed production	8850 million (2000-2001)
19. F.F.D.A. programme coverage	1,10,238.90 ha + 3102.5 units jhora
20. B.F.D.A. programme coverage	3819.625 ha
21. Hatchery establishment (Eco)	350
22. Export business (Calcutta base)	18,420 mts, Rs. 630.90 crores (2000-2001)
23. Employment generated as on 31/3/2001 through different Fisheries development Programmes	7, 82,844

fisheries development and co-operatives, River ranching, brackishwater aquaculture, social fishery, marine fishery development, introduction of patrol boats, application of remote sensing in marine fisheries, expanding welfare measures, research activities, training, extension and education, Farm utilisation, and augmenting export of marine products etc.

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Yellowfin spawn in Tanks

Yellow tuna have been successfully spawning in land-based tanks at an Inter-American Tropical Tuna Commission (IATTC) Laboratory in Panama, according to Fishing News International, April 2002 issue.

Techniques developed during a yellowfin growing study could be applied to resource enhancement or aquaculture it says, as the observation of IATTC's Daniel Marguiles-Daniel is reported to have explained that a spawning population of yellowfin tuna (*Thunnus albacares*) has been held in large tanks at the Achotines Laboratory since mid-1996.

The broodstock was developed as part of a joint project conducted at the IATTC, the Overseas Fishery Co-operation Foundation (OFCF) of Japan and the government of the Republic of Panama.

"The yellowfin broodstock has been spawning daily almost year-round since October 1996", Daniel Margulies is reported to have revealed. According to him, this represents the first successful spawning of yellowfin tuna in land-based tanks anywhere in the world. Courtship and spawning behaviours have been observed and videotaped. After each spawning event, fertilised eggs are collected, he is reported to have said. The time of spawning and hatching have been very predictable based on daily mean water temperature, it is stated.

Larvae hatched from eggs spawned in captivity have been used in laboratory experiments to examine growth and survival in early life stages.

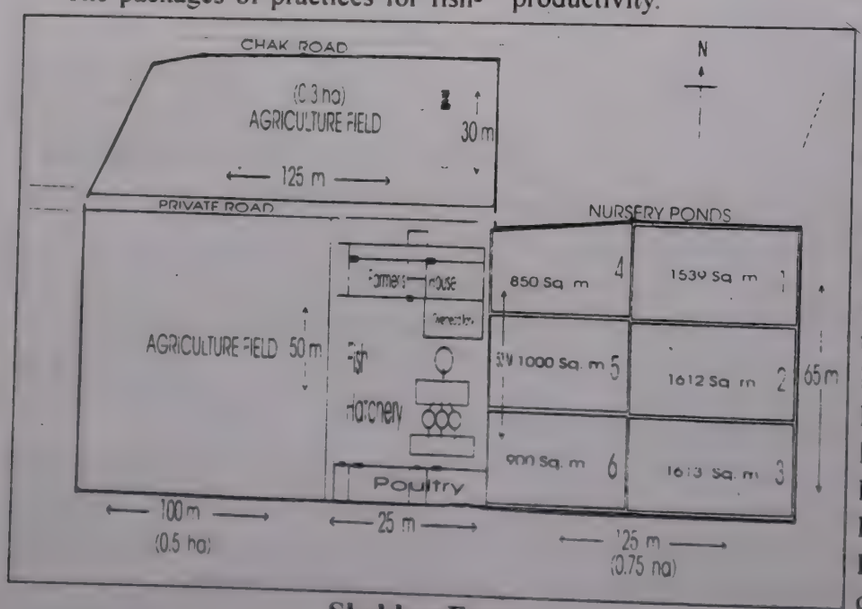
Growth in length and weight during the early stages is rapid. Juveniles have been cultured up to 100 days and are routinely reared up to six weeks after hatching, it is mentioned.

Fisheries Based Integrated Farming System

C.S.Singh
(Former Dean, College of Fisheries, Pantnagar)
Singharia, Kunraghat, Gorakhpur-273 008

As in other parts of India, Land holdings in UP are also generally small. Because of this, large scale production technology with high input requirements are no solution to the problems of the owners for obtaining viable returns. Instead, a low cost integrated farming system that includes fish culture would be suitable to the owning farmers based on the principles of productive utilization of farm wastes and economic utilization of available resources and manpower.

The packages of practices for fish-cum-dairy, fish-cum-pig, fish-cum-duck, fish-cum-poultry and fish-cum-agriculture farming systems have been developed and verified extensively for economic viability and feasibility at the farmer's level. The systems can be adopted by carrying out suitable modifications in appropriate areas (agro-climatic zones) where water resources, healthy stock of animals and agricultural land are available. In the past, various models were proposed for commercialisation of agriculture based on integrated farming system that provides a successful technique for adoption by marginal farmers. The availing of synergistic benefits of true integration, however, will require recycling of nutrients and other resources within and from enterprise to enterprise. In this background, the author has successfully developed a model farm in 1.75 ha (around 4 acres) with fish ponds serving as effective bioreactors in the process, substantially improving whole farm productivity.



Shekhar Farm
Phulwaria, Bhatpar Rani, Deoria, U.P.

This model farm known as "Shekhar Farm" has been set up in the village Phulwaria located in Bhatpar Rani Block of district Deoria. The farm has the following components conforming to integrated farming pattern: fish ponds, fish hatchery, poultry, agricultural and horticultural field, lab oratory for soil and water testing, farm house, visitors room, and lecture room with audio-visual facilities. The farm, so organised, is now being run with a sustained net income of more than a lakh of rupees per annum. Several benefits have been recorded during past three years in the village consequent to the adoption of this integrated farming system. Some of these are: 1) Minimis waste improved the environmental qua ity; 2) Reduced need for fertilizers lea ing to increased profitability; 3) I proved soil structure leading to increas fertility; 4) Increased fish production minimum inputs; 5) Improved househo nutrition by providing animal protei and 6) Minimised the migration of t rural people by providing self emplo ment opportunities.

The experiences gained show th farmers of small land holdings can b easily motivated to integrate system based on agriculture and livestock rai ing with fish culture. While integra tion of other farming systems wit aquaculture will certainly not solve a the problems faced by rural farmer sustainable integrated farming syste may provide short and medium term re lief to poor small land holders.

Acquarium fish workshop - Sri Lanka

A one day workshop on handling an packing of ornamental fish for expor jointly organised by INFOFISH and S Lanka Export Development Board wa held in Colombo on 23 January 200 The workshop was attended by near 75 participants, mostly from the indus try. The workshop was conducted by M Andrew Soh, Ornamental Fish Specia ist, *Associates Aquarium Pte Ltd* Singapore. The workshop was also ad dressed by Mr. Geoff Tilekaratne, Direc tor General, SLEDB, Mr. K. Wanniarachchi, President, Sri Lank Aquarium Fish Exporters Associatio Mr. Vibhu Perera, Chairman *Lumbi Aquaria* and Dr. S. Subasinghe, Direc tor, INFOFISH.

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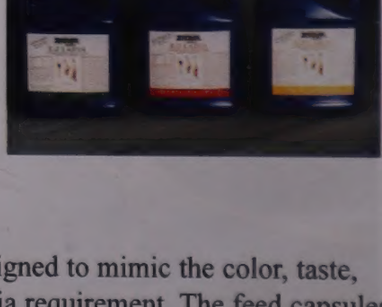

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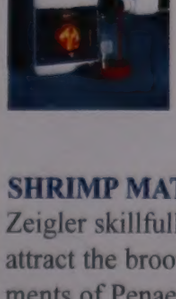

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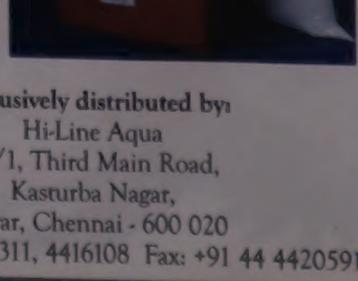

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